THE JOURNAL

OF

TROPICAL GEOGRAPHY

VOLUME FIFTEEN

JUNE 1961

PUBLISHED BY THE DEPARTMENTS OF GEOGRAPHY
UNIVERSITY OF MALAYA IN SINGAPORE AND
UNIVERSITY OF MALAYA IN KUALA LUMPUR

THE JOURNAL OF TROPICAL GEOGRAPHY

THE JOURNAL

OF

TROPICAL GEOGRAPHY

VOLUME FIFTEEN

JUNE 1961

PUBLISHED BY THE DEPARTMENTS OF GEOGRAPHY
UNIVERSITY OF MALAYA IN SINGAPORE AND
UNIVERSITY OF MALAYA IN KUALA LUMPUR

The maps and diagrams in this volume were drawn by Messrs. J. Ngai, Poon Puay-kee and Wee Hong Seene.

CONTENTS

Page

CHINESE COLONIZATION OF MALACCA, a study in population change, 1500 to 1957 A.D. - - - - - - - - - - - 1

By KERNIAL SINGH SANDHU, B.A., University of Malaya.

RELIEF AND COASTAL DEVELOPMENT IN NORTH-EASTERN JOHORE (MALAYA) - - - - - - - - - - - - 27

By J. J. NOSSIN, M.Sc., Ph.D., University of Malaya.

RECENT DEVELOPMENTS IN MEXICAN SULPHUR PRODUCTION 39

By FRANK SEAWALL, Ph.D., The Ohio State University.

THE RUBBER INDUSTRY OF THE FEDERATION OF MALAYA - 46

By OOI JIN-BEE, M.A., D.Phil., University of Malaya.

SOME FACTORS IN THE DEVELOPMENT AND PLANNING OF LAND USE IN BRITISH BORNEO - - - - - - - - - 66

By Y. L. LEE, M.A., B.Litt., University of Malaya.

THE POPULATION OF MALAYA, some changes in the pattern of distribution between 1947 and 1957 - - - - - - - - 82

By KERNIAL SINGH SANDHU, B.A., University of Malaya.

BOOK REVIEW - - - - - - - - - - - - - - 97

CHINESE COLONIZATION OF MALACCA
A STUDY IN POPULATION CHANGE, 1500 TO 1957 A.D.

By KERNIAL SINGH SANDHU

The writer is indebted to Professor Paul Wheatley, of the University of California, for his help and guidance in the preparation of this paper, which forms part of an overall plan to analyse the multi-racial population of Malaya on a mukim[1] basis.

INTRODUCTION

THE STUDY of the historical geography of Malaya is fraught with difficulties. Source material for both the pre-European and modern periods is scarce, often fragmentary and obscure. The destruction of documents by the ravages of war, vandalism, pilfering, neglect and maladministration has been so extensive that no one place in Malaya now possesses a complete set of such basic printed records as, for example, the *Annual Reports of the Straits Settlements* or the *Population Census Reports.* Furthermore, documentation of what has been salvaged has only just begun and is beset with handicaps, not the least of which is the dearth of qualified workers. Again, the inaccuracy of some of the available information renders its interpretation difficult. Typical though this is of many studies in Malaya, it is especially applicable to the study of the initial stages of Chinese immigration. Few Chinese speaking officials in the early days were competent enough to collect adequate data, and the difficulties of travel through an undeveloped country restricted contact with the Chinese miners and agriculturists in the foothills and along the valleys of the interior. Even where contact was possible the traditional suspicion of government officials made the securing of reliable data problematic.

The full story of Chinese settlement in Malaya has yet to be told. In the following pages an attempt has been made to assemble the information relating to the Chinese in Malacca — the earliest known and one of the most important centres of Chinese settlement in Malaya — and to analyse the population changes among them from the beginning of their colonization, about 1500 A.D., to 1957, the year of the last population census of Malaya and of *Merdeka* (Independence).

THE CHINESE IN PRE-BRITISH MALAYA: EARLY CONTACTS

Chinese contacts with the Malay Peninsula go back to about the beginning of the first century B.C. However, there is no mention in contemporary records of Chinese actually settled in Malaya.[2] In 1349, Wang Ta-yuan, the intrepid Chinese trader, in his description of *Tan-ma-hsi* (*Temasik,* old Singapore) made a passing reference to Chinese 'living mixed up' with the local people (1, 2). Prior to this, Chinese associations with Malaya appear to have been limited to trading contacts and brief intermittent visits of diplomatic envoys, such as Ch'ang Chun and Wang Chun-cheng who visited north-east Malaya in A.D. 607-9. Some

1. The *mukim,* a territorial subdivision for purposes of land revenue, is the smallest administrative unit of Malaya.
2. Unless otherwise stated the term 'Malaya' is used to include both the Federation of Malaya and the State of Singapore.

itinerant Buddhist pilgrims, journeying between China and India, also passed through Malaya (3).

The absence of a Chinese settlement in Malaya prior to the middle of the fourteenth century is not surprising. In the first place, the earlier Chinese do not appear to have been enterprising travellers (4a). This was probably because the Chinese regarded their country as the 'Celestial Empire', germane to which conception was the firm belief that China had everything worthwhile to give and nothing worthwhile to receive, except for a few luxury goods such as aromatic woods, herbs, peacock-feathers, pearls, ivory and rhinoceros horns, many of which could be obtained through the tribute-paying vassal states. The market for these goods in China was limited, and the status of the merchant was the lowest in the Chinese social structure, according to Confucian ideals. Chinese overseas mercantile activity had only a limited scope, there being little incentive for large-scale trading and few rewards to compensate for the hazards of ocean travel. Secondly, Chinese religious sentiment condemned the desertion of the ancestral graves as 'unfilial', and emigration was generally regarded with disfavour by the Chinese rulers, who feared that emigrant rebels would create centres for revolution overseas. Under the Ch'ing (Manchu) Dynasty (1644-1911) emigration was an offence under the penal code (5a).

Hence Wang Ta-yuan's passing reference to the Chinese 'living mixed up' with the local people in fourteenth century *Temasik* has to be viewed with caution. So far no further evidence has been uncovered to support Wang Ta-yuan's contention. But it is possible that Chinese merchants may have used *Temasik* as a rest camp, revictualling station, or even as a warehouse and a centre for the exchange of goods. The Chinese mentioned by Wang Ta-yuan could thus have been merchants waiting for the change of monsoon. It is now generally agreed that a permanent Chinese settlement on the Island probably did not exist as early as 1349.[1]

There is conclusive evidence that the Chinese settled first in Malacca, although the precise date is not clear. Malacca, founded about 1400 A.D. by a renegade Sumatran or Javanese called Parameswara, at the mouth of the Malacca River (6a, 7a), gradually developed into an important entrepôt centre. This was brought about by a succession of able rulers; its focal position at the junction of the Indian Ocean with the South China and Java Seas and its unique inherent advantages in relation to the seasonal reversal of the wind regime — a factor of great importance in the days of the sailing ship (6b, 7b, 8a). Malacca was tied to the full flow of South-east Asian trade and her life blood was commerce, there being little of value in her immediate hinterland (4b, 9, 10). This was fully appreciated by her rulers, who strove for a monopoly of trade in the area to ensure the continuing prosperity of their realm. The means they employed were twofold. Firstly, a policy of conquests and alliances — diplomatic, matrimonial and religious — with neighbouring principalities resulted in a gradual extension of their influence, and by the end of the fifteenth century Malacca controlled all the northern shore of the Straits, the most important part of the southern shore, the archipelagoes athwart its eastern approaches and sundry other island bases which had formerly harboured pirate fleets. Secondly, they fitted out a fleet of patrol boats which forced vessels to call at Malacca (11). As in the days of Sri Vijaya, the Straits again became a private sea and the control of its trade made Malacca a wealthy port-city. Following the conversion of its first ruler to Islam, probably in the second decade of

1. Paul Wheatley's view as expressed to the writer in personal correspondence.

the fifteenth century, it also became the centre and fountain-head of Islam in South-east Asia (12). This was the state of affairs in Malacca when it passed under European control in 1511.

Chinese contacts with Malacca began during the Ming Dynasty (1368-1644) when Emperor Yung Lo (1403-1424), one of the most powerful of the Ming rulers, sent out a number of naval expeditions to South-east Asia and beyond, to establish commercial relations. In 1403 he sent the eunuch Yin Ch'ing for this purpose to Malacca. The gesture was reciprocated by Parameswara who sent his envoys to China in 1405 and 1407 with tribute and presents for the Chinese emperor, and a request that his country be accepted as a dependency of the 'Middle Kingdom'. Following these initial exchanges and the visit to Malacca of the Ming Muslim Admiral Cheng Ho in 1409, when he raised Malacca to the status of a kingdom, a loose political connection was inaugurated between Malacca and the Chinese Empire accompanied by an exchange of gifts and the general acceptance of Chinese suzerainty by the Malacca rulers (13, 14, 15a). However, these diplomatic links and the renewed Chinese mercantile activity do not necessarily mean that there was a permanent Chinese settlement in Malacca before its conquest by the Portuguese in 1511. This problem has yet to be resolved.

Date of First Settlement

The theory of the Chinese settlement in Malacca is based on contemporary Chinese, Malay and Portuguese records, but the evidence available as to the exact date is inconclusive.

Chinese Evidence. Most of the Chinese literary evidence pertaining to fifteenth and sixteenth century Malacca is contained in the accounts of Fei Hsin (16), Ma Huan (17) and Hwang Chung (18). Fei Hsin, a scholar who visited the *Nanhai* ('Southern Seas') in the suite of Cheng Ho, states that 'the people of Malacca are rather dark in skin but those who are fairer in complexion are the decendants of the Chinese' (15b). But Ma Huan, a Muslim interpreter who also accompanied Cheng Ho on some of his numerous expeditions into the *Nanhai,* the Indian Ocean and beyond in the first third of the fifteenth century, though recording that Malacca was visited by Chinese merchants, makes no mention of a Chinese settlement there then (4c).

A century later, Hwang Chung, the Chinese traveller who visited Malacca, states that pork was eaten by the Chinese 'who live here' (Malacca) (5b). This implies that at some time previous to 1537 the Chinese had begun to reside in Malacca. But a further reference suggests that the Chinese in Malacca at this time were only sojourners, for the *Hai yu,* referring to the Chinese as 'merchants of the ships', goes on to say that they 'live in an hotel, the chief of which always sends female slaves to serve them and sends their food and drink morning and evening' (4d). Chinese literary evidence, therefore, is not very conclusive in fixing the date of the earliest Chinese settlement in Malacca.

Chinese epigraphical evidence is also of limited value in dating the initial Chinese settlement in Malacca. Some of the oldest Chinese relics extant in Malacca, or for that matter in Malaya, are to be found on Bukit China (Fig. 1), which forms an enormous Chinese burial ground believed to be the largest of its kind outside China. A few old graves with coral tombstones, the inscriptions of which are no

longer legible, are still discernible on Bukit China. The Rev. Yeh Hua Fen is of the opinion that some of them may date back to the early sixteenth century, if not earlier (15c). But the family traditions of the present-day Malacca Chinese do not suggest such an early date for the Chinese settlement in Malacca; none of the family records go back further than the first half of the seventeenth century (5c).

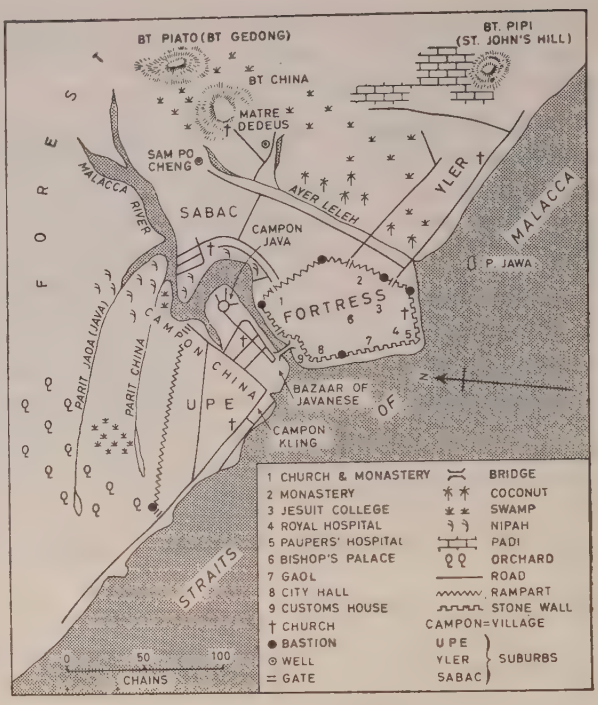


Fig. 1. Portuguese Malacca.

Malay Evidence. Contemporary indigenous writings are no more definite in indicating the date of the earliest Chinese settlement in Malacca. The *Sejarah Melayu* (Malay Annals), the earliest extant work in Malay of about the middle of the sixteenth century, contains a fascinating tale of how Sultan Mansur Shah (1446-1459) of Malacca married Princess Hong Li-po, daughter of the Emperor of China, after her conversion to Islam, while the five hundred hand-picked Chinese maidens who accompanied the royal bride were also similarly espoused by the courtiers of the Sultan (19). These Chinese built their houses on the hill, now known as Bukit China, and their descendants were denominated by the Sultan, as *beduanda china,* or Chinese personal attendants. To commemorate the occasion of the royal neptual the Chinese are supposed to have dug one of the five wells extant at the foot of Bukit China, and known to the Malays as Perigi Raja, or King's well, and to the Chinese as Sam-po-cheng or Sampo's (popular Chinese name for Cheng Ho) well (20a) (Fig. 1).

The above account implies that there may have been a settlement of Chinese, or at least half-Chinese, in Malacca by about the middle of the fifteenth century. The *Sejarah Melayu,* however, is notoriously inaccurate in historical detail, being for the most part court panegyrics and popular legends handed down by word of mouth through successive generations. Furthermore, it is doubtful if Hong Li-po was the Chinese Emperor's daughter, for, if she was, the usually factually reliable Chinese State Chronicles would scarcely have missed mentioning such an auspicious event (21). Neither do the Portuguese accounts of the period make mention of this incident (15d, 4e, 5d).

Portuguese Evidence. Portuguese evidence bearing on early Malacca is the most extensive of that in any language (15d, 4e, 5d). But while these records are the most valuable single corpus of evidence on Portuguese Malacca (1511-1641), the same, however, cannot be said of their writings on pre-Portuguese Malacca, since these have been compiled retrospectively and are often based on unidentified authority. Consequently they have to be treated with caution.

Braz (Afonso) de Albuquerque (1500-1580), the bastard son of Afonso de Albuquerque the conqueror of Malacca and Governor of Portuguese India (1509-1515), recording the history of his father's activities in India and Malacca, mentions that in the Malacca Sultanate (c. 1415-1511) four *Xabandars* (*Shabandars*), or port officers, were appointed to help the administration of justice in the case of foreigners. One of these was a Chinese (8b, 22). In addition, Albuquerque states that the second Sultan of Malacca, Sri Maharaja (1424-1444), married a daughter of the Captain of the King of China (8c). Captains for the Chinese, or *Kapitan China* as they were more popularly known in Malaya, were normally appointed as headmen of their communities. The presence of a Captain and the *Xabandar* suggests that there was a Chinese community in Malacca. However, it is possible that these Chinese may have been temporary residents only, coming and going with the reversal of the monsoons. Furthermore, a permanent Chinese settlement, as early as 1424-1444, is not substantiated by any other evidence.

The presence of Chinese merchants in Malacca, prior to the arrival of the Portuguese, was also mentioned by Dona Jeronomo Osoria in 1571. He dwells at length on the help given by these Chinese merchants to Sequiera, the first Portuguese captain to visit Malacca, in 1509 (5e).

Relationships between the Chinese and the rulers of Malacca had been deteriorating for some time following the ill-treatment of Chinese merchants by the Malays, and when the Portuguese attacked Malacca in 1511 the five Chinese junks present in the harbour and the Chinese merchants of the city all sided with the Portuguese against their erst-while friends (8d).

The Portuguese accounts so far are the most definite. The main implications of the above evidence are fairly clear. There can be little doubt that by 1511, if not earlier, there was a Chinese trading community in the port-city of Malacca. But as to whether these Chinese represented a permanent or a fluid society, that kept coming and going with the monsoons, is still uncertain. By the beginning of the seventeenth century, however, there is little doubt about the existence of a permanent Chinese settlement in Malacca, for by this time the Chinese were present in sufficient numbers to have a 'Campon[1] China', a special quarter of their own, in the city of Malacca near the present-day Second Cross Street (Figs. 1 and 9B). The Portuguese cosmographer and explorer de Eredia, who lived in Malacca for the first four years of the seventeenth century, in his account of the territory, describes 'Campon China' at some length (23a). He says that it formed part of the suburb of Upe (present-day Tranquerah), and extended 'from the Bazaar of the Jaos (Javanese) on the beach and from the mouth of the river (of Malacca) in a north-easterly direction for a distance of 400 fathoms along the bank of the same river to the gate (of the *Chincheos*) and the earth wall which forms part of the rampart; and beyond the marsh-land again as far as the "Nypeiras" or wild palms beside the stream of Paret[2] China'. Here lived the *Chincheos,* or Chinese of the Fukien Province of South-eastern China (23b, 20b).

Population Numbers and Characteristics: The Malay Kingdom and the Portuguese Period, c. 1400-1641

There is no indication in the above evidence of the size of the Chinese community in Malacca during the period of the Malay kingdom. It could not, however, have been large, since the total population of Malacca in 1414 was

1. Campon=kampong, Malay for village or hamlet.
2. Paret=parit, Malay for drain.

estimated, by Tomè Pires the Portuguese apothecary who was resident in Malacca during 1512-1515, as being only 6,000 inhabitants of whom the majority were Malays (24). Also, no figures are available for the Chinese in Portuguese Malacca. But to judge from the size of 'Campon China', as described by de Eredia, it would appear that the Chinese must have been present in substantial numbers by at least the first decade of the seventeenth century. Relationships between the Portuguese and the Chinese in the early stages were cordial, and it is possible that Malacca may have received numbers of Fukien (Amoy) emigrants who left China during the latter part of the Ming Dynasty (25, 26a). At the time of the Dutch capture of Malacca in 1641, there were 300 to 400 Chinese in the State (27a). There is reason to believe that the number of Chinese settlers sometime prior to the Dutch occupation had been higher than this. It appears that the monopolistic trade policy of the Portuguese coupled with the corruptness of their officials had obliged many merchants, including Chinese, to leave Malacca during the latter part of Portuguese rule (28). In addition, this policy of the Portuguese brought them into conflict with other nations, and Malacca was constantly besieged first by neighbouring South-east Asian states and later by the Dutch. These wars took a heavy toll of those who remained behind, and by the time of the Dutch capture Malacca was a ruined city of only 2,706 inhabitants compared with an estimated figure of 20,000 for the pre-Dutch period (27b). In fact, so drastic had been the decimation of certain sections of the Chinese population that the Dutch had to import Chinese from Batavia to work the fields and gardens of Malacca (29). Schouten, the Dutch emissary, visiting Malacca in 1641, enumerated thirty-three such Chinese immigrants among the estimated 300 to 400 Chinese merchants, craftsmen and fishermen living in the Upe and Sabac (modern Bunga Raya) suburbs of the city (Figs. 1 and 9B) (27c).

The Dutch Period. The return to peaceful conditions after the cessation of Portuguese-Dutch conflict witnessed an increase in the number of Chinese in the State. In 1678 Balthasar Bort, the Dutch Governor of Malacca, enumerated 426 Chinese among the total population of 4884 (30a). According to Bort the Chinese community comprised 127 men, 140 women and 159 children. The females among the Chinese were probably Batak and Balinese slaves, whom the Chinese males married in the absence of Chinese women (31a). Chinese female immigrants did not start arriving in the Straits Settlements until about the middle of the nineteenth century (32, 33). Seventy-eight of the Chinese lived around Bukit China, the rest were in the northern suburb ('Upe' of the Portuguese). These Chinese, principally merchants, artisans and carpenters, were comparatively wealthy, owning 81 brick and 51 *atap*[1] out of a total of 185 brick and 583 *atap* structures in the whole territory (30a). In addition, they owned 290 slaves (30b).

The Dutch were anxious to persuade 'the industrious Chinese' to settle in Malacca for the cultivation of the soil and other traffic (27d). In response to Dutch encouragement the Chinese population increased to 2,161 by 1750, a five-fold increase over the 1641 estimates (34). It is possible that some of this was the result of natural increase in the Sino-Batak or Sino-Balinese homes. This situation which was conducive to population growth was short-lived. In the first place the monopolistic trade policy of the Dutch, like that of their predecessors, led to a gradual strangulation of Malacca's trade, whilst restrictions on movement and a poll tax of a quarter guilder per person per month imposed on the Chinese, to boost the revenue of the State, discouraged the new immigrants (30c). Secondly, the comparative decline of Dutch influence in the eighteenth century, and the rise

1. Malay for roofing thatch.

of British power led to the establishment of Penang as a trading station in 1786. This proved to be a major set-back to Malacca's fortunes. British rule and *laissez faire* trade policy, with which the Chinese had come into contact elsewhere in South-east Asia and which they viewed favourably, accounted for the transfer of numerous Chinese from Malacca to Penang. In fact, Captain Francis Light, the founder of Penang, writing in 1787, avers that if the Dutch did not keep a strict watch over the Chinese the majority of them would leave Malacca (35). Thirdly, Malacca's harbour is shallow and as ships increased in size this became a formidable handicap. Fourthly, following the outbreak of the Napoleonic Wars in Europe, Malacca was occupied in 1795 by the British, who set out to render it useless to any other European power should they ever acquire it. In 1807 the fort at Malacca was destroyed by the British at a cost of 260,000 rupees, and it was planned to shift the trade and the populace of the city to Penang (36a). This would have ruined Malacca for good but for the timely intervention, in 1808, by Stamford Raffles the British Resident in Malacca. Enough damage, however, had already been done, and by 1817 the Chinese population in Malacca had dwindled to 1,006 (34). The founding of Singapore in 1819 finally sealed the fate of Malacca as a major trading centre. With its superior location in relation to ocean shipping and its excellent harbourage facilities, Singapore soon outgrew not only Malacca but also Penang. Malacca, though it became comparatively prosperous again in the present century, following the establishment and expansion of the rubber industry, never recovered its former importance. However, it continued to be a place of great interest and the Elysium to which the rich Straits-born Chinese retired, or hoped to retire (37).

THE CHINESE IN BRITISH MALACCA

Population Numbers, Composition, Distribution and Density in Early British Malacca, 1824 to 1914

By the Anglo-Dutch Treaty of 1824, which delimited British and Dutch spheres of influence in South-east Asia, Dutch interests were confined to the area now occupied by Indonesia, and Malacca became a British possession. The focus of attention in Malacca thereafter gradually shifted from the sea to the hinterland — as an alternative field of endeavour and source of income — since the port of Malacca could not hope to compete with the better placed entrepôts of Singapore and Penang. The population began to increase again as more and more cultivators, speculators and artisans took part in the new ventures of the interior.[1]

The increase of Chinese settlers in Malacca was especially rapid in the first few years under the British. Ward, a British medical officer stationed in Malacca about 1827, recorded that the Chinese were still concentrated in the north-western part of the town, and numbered 3,989, that is nearly a third of the total population of 12,687 free people (38). This represents an increase of nearly 300 per cent on the Chinese population of 1817. They also possessed 521 of the 1,493 slaves and slave-debtors. Newbold on the other hand, quoting the Census[2] of the Residency of Malacca, stated that the total population was 31,441, of which 5,200 were Chinese (36a). It is possible that Newbold's figure is inaccurate, since the Chinese population in the decade 1826-36 appears to have fluctuated between 4,000 and 4,700, except for the years 1827 and 1832 (Table 1).

1. See pp. 11-15 below.

2. The word 'census' is used here in a very general sense, as the first detailed population census of the Straits Settlements was not taken until 1871.

TABLE 1: CENSUS OF THE RESIDENCY OF MALACCA, 1826 TO 1836, (36b)

	1826	1827	1829	1832	1833	1834	1835	1836
Chinese Population	4,125	5,200	4,764	3,862	4,764	4,143	4,613	4,102
Total Population	28,505	31,441	34,492	—	33,129	34,339	37,237	37,906

The fluctuation was partly due to the movements of Chinese between Malacca, Penang and Singapore for business purposes and in search of work, and the movement of tin miners between Malacca and Negri Sembilan (39). Furthermore, unsettled conditions during the war between the native State of Naning (part of Negri Sembilan) and the British in 1831-32, which resulted in Naning being incorporated into Malacca, help to explain the comparatively low number of Chinese in Malacca at that time.

Between 1836 and 1911, with the exception of the periods 1852-60 and 1881-91 when there were small decreases as a result of emigration to other more attractive areas, the Chinese population continued to increase steadily at the rate of about twenty per cent per decade to reach 35,450 out of a total of 124,081 inhabitants in the State in 1911. This rate of increase for the Chinese was very much higher than that for the total population of the State, for while the latter increased by 225 per cent between 1836 and 1911 the Chinese population registered a 780

TABLE 2: THE POPULATION OF MALACCA, 1842 TO 1911, (34, 40a, 41a, 42a, 43a, 44a)

	1842	1852	1860	1871	1881	1891	1901	1911
Chinese Population	6,882	10,608	10,039	13,456	19,741	18,161	19,468	35,450
Total Population	46,097	62,514	67,267	77,756	93,579	92,170	95,487	124,081

per cent increase in the same period (Table 2). But this overall rate of increase hardly tells the whole story as there were numerous local variations. For example, during the 1891 to 1901 inter-censal period, a decrease of as much as 89 per cent was recorded in the mukim of Bukit Baru whereas an increase of 8,100 per cent occurred in Mukim Machap (Fig. 3B). These decreases in some mukims and large increases in others were generally the result of the movement of tapioca and gambier planters, employing shifting cultivation techniques, from one locality to another.

In the absence of accurate statistics it is difficult to assess how much of the above increase in the Chinese population of Malacca was the result of an excess of births over deaths, and how much was due to a migrational surplus (45a). In the initial stages Chinese male immigrants married Batak and Balinese slave women,

giving rise to a mixed Sino-Malaysian community popularly referred to as *Babas*[1] or *Peranakans* (36c, 38). Later, however, much of the increase was the result of a migrational surplus. This was probably because the abolition of slavery in the early part of the nineteenth century deprived the Chinese of their source of Batak and Balinese slave women. Also, many of the slaves in Malacca adopted the Islamic faith, which, together with other social taboos, formed a serious barrier to inter-racial marriage for the Chinese, nearly all of whom were non-Muslims. Again, the early Chinese migrants were mostly adult males (46), as Chinese female immigration, other than the illegal movement of prostitutes (47), appears to have been delayed until the middle of the nineteenth century, when an Amoy merchant returning to Singapore from China brought his entire family with him (33, 48).

The immigration of Chinese women in large numbers into Malaya did not occur until the present century (49). There were a number of reasons for this. Firstly, all emigration was forbidden by the Manchu Government (1644 - 1911) in China until 1860 (50). Although the right of emigration after this date was recognized in principle, the Act forbidding emigration was not repealed until 13th September, 1893 (51a). Males generally were able to evade it but it was strictly enforced in the case of women. This was done so that erring male emigrants would be forced to return to China to marry and to see their parents or at least send remittances (52). Secondly, certain obligations in the Chinese cult of ancestor worship and social organization, especially the concept of filial piety and care of the family, made it difficult for women to emigrate. This was particularly so in homes where the husband was away, in which circumstances the wife had to take over all the social obligations of the husband (53, 54). Thirdly, the social status of women in the traditional Chinese society was one of inferiority: their place was considered to be in the home and their prime duty the bearing of children who should be reared in China. Women seldom went beyond the limits of their particular village (55). Fourthly, emigration from China in those days was a hazardous undertaking. Conditions on the junks were far from suitable for females from conservative Chinese families. Furthermore, nineteenth century Malaya, with its diseases and generally unsettled conditions, was not a particularly attractive place for women. Lastly, there may well have been little encouragement for single females to emigrate. Respectable Chinese either returned to China to marry, or married the daughters of the Straits-born Chinese[2] of Malacca, Penang or Singapore (56). Single women who came to the Straits Settlements from China prior to about the middle of the nineteenth century were usually prostitutes, and were imported as such (57, 58, 59). In these circumstances it is not surprising that even as late as 1911 there were only 204 females to every 1,000 males amongst the Chinese of Malacca, and the immigration of male fortune seekers was still the major factor promoting increase in the Chinese population (44b).

The majority of the male immigrants were Hokkiens, Hakkas, Cantonese, Tiechius and Hailams (Hainanese), with the first two forming 60 per cent of the total (44c). They came from the maritime provinces of South-eastern China

1. The *Babas* appear to be principally of Hokkien descent and their 'Baba-Malay language' has a great deal of Hokkien in it. The Baba version of Malay, a mixture of Chinese and Malay with the latter predominating, is the language commonly spoken in Baba homes. The majority of the Babas cannot speak Chinese, though they still retain their Chinese customs and manners and bring up their children as Chinese. They tend to marry within their group, which even today forms a substantial and distinctive part of the Chinese population of Malacca.

2. Chinese born in Malaya, particularly in the Straits Settlements (Penang, Malacca, and Singapore).

(Fig. 9c). The predominance of Chinese from South-east China may be attributed to a number of factors. Firstly, the south-eastern maritime provinces of China were nearest to Malaya. There was also some similarity of climate between south-eastern China and Malaya, making acclimatization less difficult than for emigrants from the colder northern parts of China. Furthermore, travel was aided by the wind systems of the South China Sea, where the monsoonal regime was such that for five months of the year sailors could rely on a steady wind to carry them to the Malay Peninsula, and for another four months equally reliable winds would take them back to China. Secondly, prior to about the middle of the nineteenth century, Chinese contacts with foreign traders were confined almost wholly to the Kwangtung and Fukien ports, especially Canton. These contacts with Westerners broke down many of the fears and prejudices about the outside 'barbarian' world (60, 61). Demands for labour associated with the capitalistic development of the colonies of western powers in the nineteenth and early twentieth centuries also encouraged Chinese migration. Following the First and Second Opium Wars, Britain insisted that a clause be inserted in her treaties with China legalizing Chinese emigration (51b). The Viceroy of Canton, in 1859, agreed to Chinese emigration from Canton (26b), and by 1870 official opposition in China to emigration had largely disappeared. In the Burlingame Treaty of that year the Chinese emperor 'cordially recognised the inherent and inalienable right of man to change his home and allegiance, and the mutal advantage of the free migration and emigration of aliens and subjects respectively from one country to another for the purpose of curiosity, of trade or as permanent residents' (51b). These developments stimulated emigration, and, since the foreign contacts and interests were mainly limited to the south-eastern parts of China, this region had the advantage of first choice and a head-start over others. Once the stream had started it tended to flow from the same source, and the jealousy of the linguistic groups already settled tended to keep out those from other provinces. Thirdly, Hokkiens, Cantonese, Tiechius, Hailams and to some extent Hakkas, have always been regarded as the most enterprising of the linguistic groups of China (62). Long before Southern China was conquered by the Han Chinese about 111 B.C. and its subsequent sinicization, its inhabitants, then known as the Nan Yüeh people, had been traders, travellers and expert sailors. Fourthly, pressure of population,[1] poverty and general economic stress were China's constant liabilities and powerful agents forcing people to seek their fortunes in places other than their own depressed localities (63a, 64). These economic hardships were aggravated by political and social unrest generated by local revolutions and political manoeuvrings, as for example, the civil war between conflicting North and South interests. Whilst nearly all the settled parts suffered from these disturbed conditions the situation in South-eastern China was particularly acute (63b, 65). This region was the one that opposed the Manchu Dynasty the longest. Political persecution forced many Chinese to emigrate, and quite a number were criminals escaping from the over-crowded jails of ports like Canton (31c, 66, 67).

Chinese emigrants bound for the Straits Settlements embarked principally at the ports of Canton, Swatow and Amoy. Until the advent of the steamship, about the middle of the nineteenth century, junks were the means of transport (68, 69). These junks, of 300 to 400 tons, took twenty to thirty days to complete the journey from the South Chinese ports to Singapore the principal port of entry into Malaya. Bringing emigrants from China was a profitable business and the kidnapping of

1. For example, the cultivated land in China only increased from 550 million *mou* to 742 million *mou* (6.6 *mou* = 1 acre) between 1661 and 1833, or roughly by 35 per cent, while the population rose from 143 million in 1741 to 432 million in 1851, that is about 200 per cent.

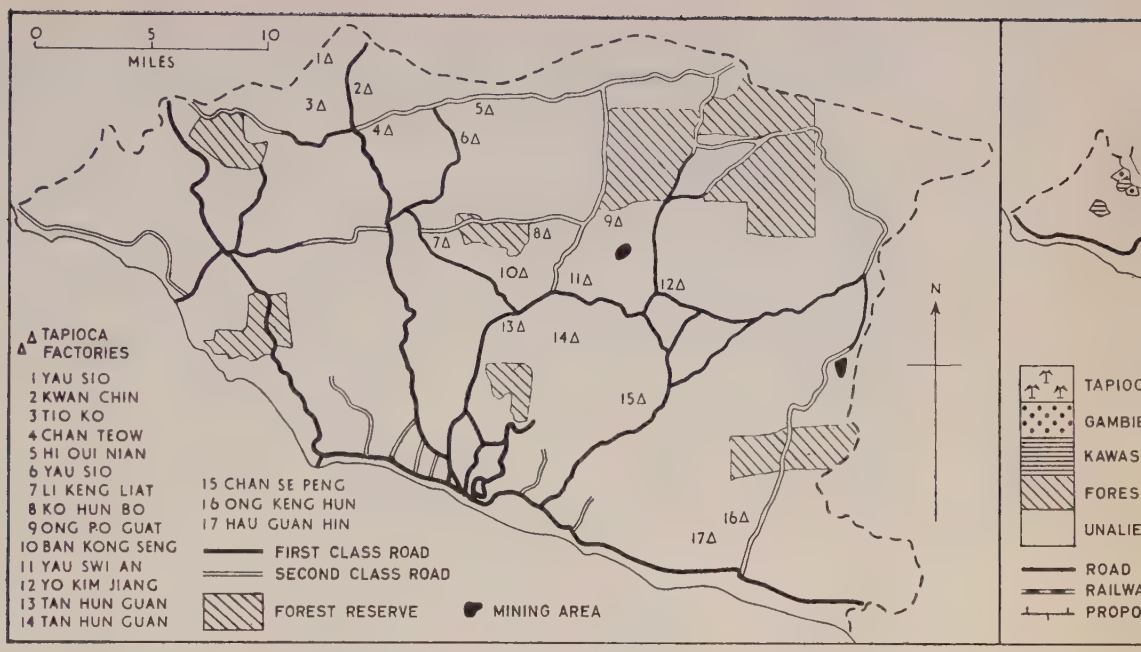


Fig. 2A. Land use, 1888.

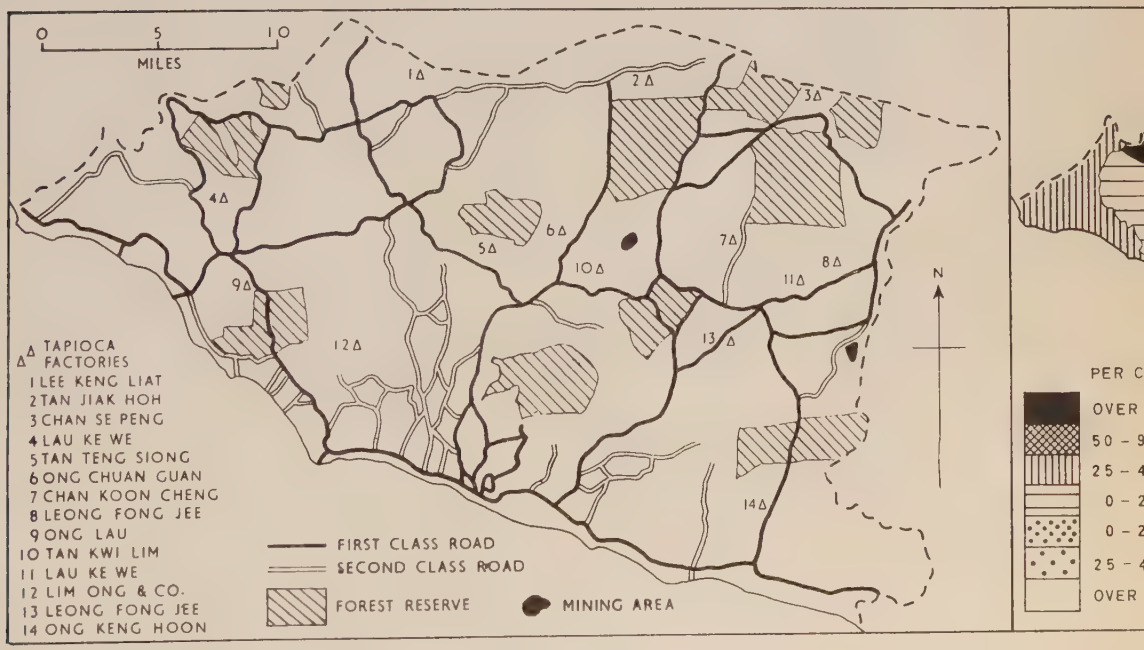


Fig. 3A. Land use, 1903.

labourers was common in Swatow and Canton (70). As many as a thousand persons were often 'huddled together like pigs' in each junk (71a, 72). Deaths from over-crowding in these 'floating hells' were many (73).

The majority of the early emigrants were so poor that they were unable to pay their passage, which amounted to M$4.00 by junk, and M$5.50 to $8.00 by steamer. They generally came to Malaya under a system known as the 'Credit Ticket System' (71b). Under this system labour brokers in the ports of South China, working in conjunction with their counterparts in Singapore, paid the expenses of the voyage for batches of emigrants (known as *sinkehs*[1]). On arrival in Singapore the sinkehs were sold to the highest bidder, for whom they had to work until their sale value was paid off. Government control of immigration and conditions of employment within the Straits Settlements in the nineteenth century were lax, and local *towkays*[2] seldom allowed the sinkeh to work off his debt. They employed the sinkehs on a 'truck system', based on the practice of paying the workmen in goods instead of money, or in money on the understanding that they would buy provisions or other goods from their employers. In addition, the employers usually had monopolies of opium, liquor and gambling 'farms'. They supplied the sinkehs with *chandu*[3] and spirits, and then, by crooked gambling, swindled them of whatever money they had left. In this manner many of the sinkehs were kept in permanent debt until death (74, 75, 76, 71c). Life for the early Chinese immigrants to the Straits Settlements was harrowing, and arduous working conditions were aggravated by poor health control measures. The wastage of life in Malacca, as in the other parts of Malaya, was appalling. Losses, due to disease and exhaustion, were sometimes as high as 75 per cent of the original labour force (71d). But this state of affairs was generally not known in China. To the average Chinese of the South-eastern maritime provinces of China, Malaya represented an *El Dorado* where fortunes could be amassed — a great contrast to the constant struggle for survival in China.

It was mainly trade in the earlier stages that attracted the Chinese to Malacca. Chinese traders, according to Ward, were the 'most enterprising, most opulent, the most industrious and the most determined in pursuit of wealth'. By the eighteen-twenties, if not earlier, almost all the retail and much of the wholesale trade of Malacca was in their hands. In addition, they were the principal artisans, craftsmen and manufacturers (38).

The other main attraction for the early Chinese immigrants to Malacca was its mineral wealth, which, though negligible to-day, was quite important in the first half of the nineteenth century. Tin and gold were the principal minerals mined in Malacca. Initially the mining of these minerals was exclusively a Malay monopoly, but as the number of Chinese increased more and more of them became interested so that by the eighteen-sixties mining had become largely a Chinese undertaking (77).

There were between twenty and thirty Chinese gold-miners in the foot-hills of Mt. Ophir in 1817. By 1848 the number had increased to 250, producing some 24 *katis*[4] of gold annually (78). But the chief mining activity was for tin. The

1. *Sinkeh,* Chinese for new arrivals or 'greenhorns' in *Nanyang* (South-east Asia).
2. *Towkay,* Chinese for head of family or business. Used colloquially to denote owner of property or wealth.
3. *Chandu,* Malay for prepared opium.
4. The *kati* is a local measure of weight approximately equal to 1⅓ lb.

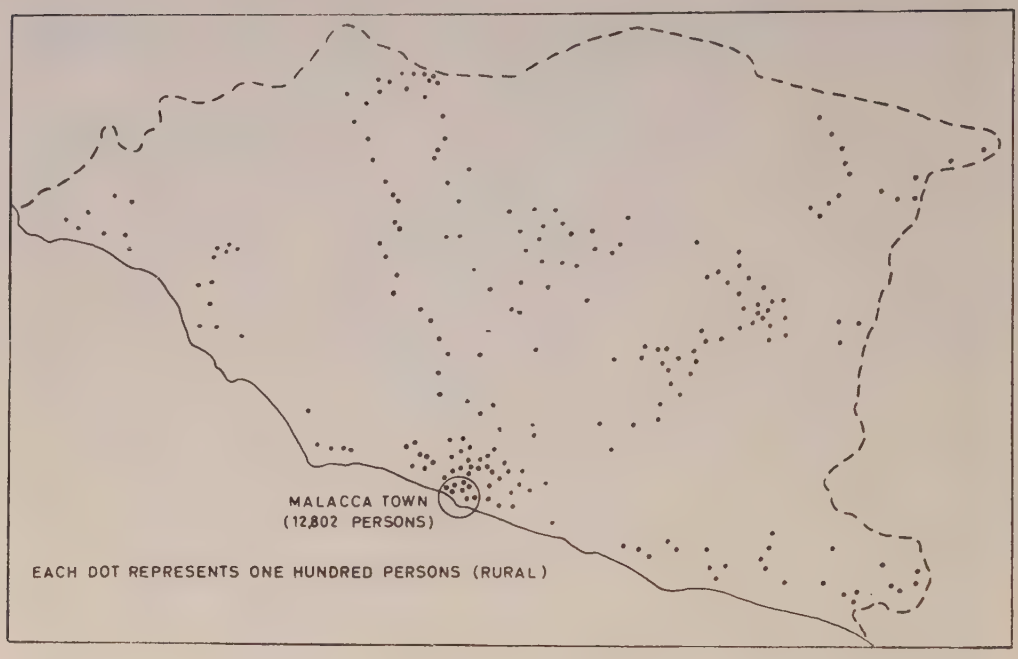


Fig. 4. Distribution of population, 1911.

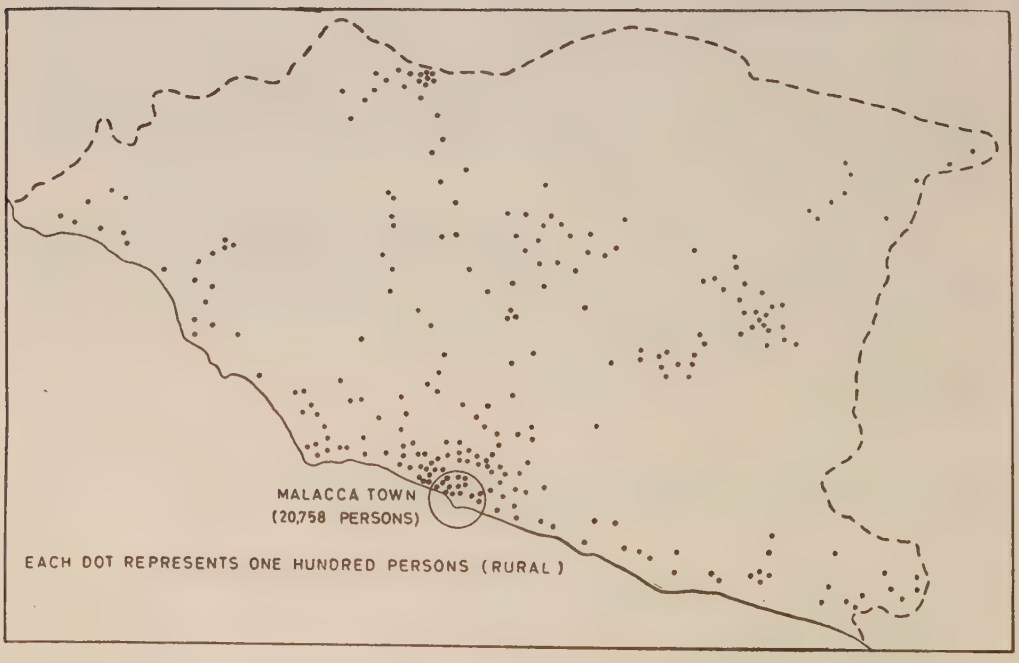


Fig. 5. Distribution of population, 1921.

first tin mine in Malacca was worked by a Chinese in 1793 at Titian Akar, about eleven miles from Malacca town. By 1840 there were several mines in the Lendek; Durian Tunggal; Ayer Panas and Kesang areas: the last mentioned being the principal region (Figs. 9D and 9E). In addition, numerous Chinese miners from Malacca were engaged in mining operations across the border in Negri Sembilan, particularly in Sungei Ujong, where in 1830 there were 400 of them (71e, 39).

Tin mining activities expanded rapidly during the early eighteen-forties and by 1848 there were 2,200 Chinese miners in Mukim Kesang alone, with a further 1,200 in the Durian Tunggal, Naning and Ayer Panas areas (79, 80). Tin production for Malacca then was 4,277 *pikuls*[1] per year, all of which was exported (78). Blundell, the Resident Councillor of Malacca, on the other hand avers that there were about 200 mines and some 6,000 to 7,000 miners in Malacca between 1847 and 1848, whilst exports of tin amounted to 23,500 pikuls (81). But this total also included some of the tin exports from the adjoining State of Negri Sembilan. The tin deposits of Malacca, however, were meagre and were soon depleted with the result that by 1871 there were only five mines operating in the State. They employed twenty-nine men and produced 237 pikuls of tin (40b, 82, 83, 84). By 1911 there were only four mines, in Mukims Chinchin and Kesang (Figs. 9D and 9E), producing some 50 pikuls of tin (85a).

To-day there are no tin mines operating in Malacca (86). With the decline in tin mining, agriculture expanded rapidly, particularly in the second half of the nineteenth century. Until then primary food production had little appeal for the Chinese, who preferred commercial crops promising quick cash returns (87, 88). The introduction of cash-crops on a large scale in the second half of the nineteenth century led to a large influx of Chinese cultivators into Malacca. This kind of agriculture was favoured by the gently rolling, freely drained and easily accessible interior of the State (Fig. 9A).

The new commercial crops pioneered by the Chinese in Malacca included cotton, cinnamon, nutmegs, tapioca, pepper, gambier and rubber; the last four being the most important (15e, 89, 90, 91, 92, 93a). Tapioca, which later yielded profits as high as M$64,000 per year per 1,000 acres, began to attract the attention of Chinese farmers in the eighteen-fifties (94a). It was used as a pig fodder and for the manufacture of sago. Peak production was reached in the late eighteen-eighties. By 1871, there were thirty-three estates totalling 19,000 acres under the crop in Malacca, producing 8,250 tons (138,950 pikuls) of tapioca, valued at £110,000 (40c). The main areas were in Mukims Ayer Panas, Durian Tunggal, Lendu, Machap, Pengkalan Rama, Tanjong Minyak and Paya Rumput. Tapioca cultivation spread rapidly to other areas, such as Jasin, Merlimau and Pulau Sebang (Figs. 9D and 9E), and by 1881 there was a record of 72,036 acres under this crop, while the number of tapioca factories increased to forty-seven (41b). The cultivation of tapioca was usually combined with the rearing of pigs. Thus, with the development of tin mining in Kinta (Perak), the export of pigs to feed the Chinese miners there became an important integral part of the tapioca industry. For example, while only 839 pigs were exported from Malacca to other parts of Malaya in 1871, ten years later this number had more than doubled, and in 1881 the annual exports from Malacca included 1,871 pigs, mainly to Kinta (40d, 41c).

Tapioca planting, however, is an exacting and ruinous form of agriculture, particularly as practised by the early Chinese farmers who employed a shifting

1. One *pikul* = 100 katis = 133⅓ lb.

cultivation technique. They laid waste valuable land with the result that in 1886 the Government decided not to grant any more land for tapioca planting (94b). By the second decade of the present century the cultivation of tapioca as a commercial enterprise had ceased, being superseded by such crops as gambier and rubber, particularly the latter (Figs. 2A, 2B, 3A and 6A) (85b, 95, 96, 97).

Gambier and pepper planting, insignificant in the eighteen-sixties, became an important pursuit among the Chinese, following favourable prices and constantly high demands from local tanners and dyers, and from Singapore merchants for export to Europe (98, 99). By 1881 there were sixty-four gambier factories operated by Chinese shifting cultivators, principally in Mukim Ayer Molek (Figs. 9D and 9E) (41b). In the next ten years, following the influx of more Chinese, the number of gambier factories increased to 202 and the area under gambier and pepper amounted to 7,800 acres (97). The centre of cultivation by this time had shifted to Mukim Sungei Baru Ilir (Figs. 9D, 9E and 2B). The peak of gambier and pepper production was reached in 1911, when 11,920 acres were devoted to these two crops (85b). With the development of the rubber industry and a fall in demand for gambier in Europe, following the availability of cheaper alternative sources of tanning and dyeing materials, gambier and pepper growing gradually declined as a commercial enterprise among the Chinese (84, 95, 100).

Rubber, which revived Malacca's fortunes, was not grown commercially in Malaya until the end of the nineteenth century. Hislop Hill, a coffee planter, who planted a few rubber plants as an experiment among his coffee trees in Negri Sembilan in 1883, was traditionally, but incorrectly, considered the first rubber planter in Malaya (101). As later research has shown, the credit really belongs to a Malacca born and educated Chinese land-owner, Tan Chay Yan, who in 1895 began the first commercial rubber 'garden' (93a, 102). Recognizing that rubber had a market, but still uncertain of his venture, he planted Indian rubber, fig and para rubber trees together on forty acres of land at Bukit Lintang, behind Malacca town. In 1898, as the head of a Chinese syndicate, he planted the Bukit Asahan Estate (Mukim Chabau), in the north-east corner of Malacca territory, with para rubber trees (Figs. 9D and 9E). From these modest beginnings the cultivation of rubber spread rapidly, so that nine years later the acreage in Malacca was almost 50,000, and by 1912 it reached 115,000 acres (Fig. 6A) (84, 93b).

The establishment and rapid expansion of the rubber industry in Malacca was aided by a number of factors. In the first place, the natural conditions of soil and climate were ideal. Secondly, a skeleton road system had already been laid to serve the tapioca and gambier industries. Thirdly, proximity to China and India ensured abundant supplies of cheap and efficient labour. Fourthly, the advent of the motor car immensely increased the demand for rubber. Fifthly, booming prices which rose from two shillings per pound in 1900 to twelve shillings by 1910 brought enormous profits, which could be ploughed back into the industry. Sixthly, by 1914 systematized production and settled labour conditions enabled Malaya to deliver rubber in New York at a cost less than that for rubber shipped from the Amazon (103a). Seventhly, the ease with which land could be acquired facilitated the rapid expansion of the cultivated area (restrictions on new planting and on land acquisition were not imposed until the depression of 1920 - 22) (104). Leases in perpetuity for 1,000 acres in one block, or in blocks of not less than 500 acres each, could be obtained at a quit rent of only 20 cents per acre after two years of free occupation by any *bona fide* planter. Eighthly, loans were available from the Government at moderate rates of interest. Finally, research by the Planters' Association of Malaya (founded in 1907) and the Department of Agriculture

(established in 1905) kept Malaya well in the lead in the technical field of the industry (105).

The rapid expansion of the rubber industry gave a new lease of life to Malacca, and led to a fresh influx of Chinese cultivators and labourers. In the initial stages Chinese were the main source of labour for the rubber estates, but after 1905 large numbers of South Indians were recruited for this purpose. The expanding rubber industry was accompanied by an improvement in communications (Cf. Figs. 2A, 2B, 3A and 6A) and in administration, ensuring not only ease of movement of goods and people but also security of person and property. These developments removed one of the major deterrents to immigration, namely insecurity. All these, together with the removal of restrictions on emigration from China and the improvement in ocean travel following the inauguration of steamship passenger services, led to increased immigration. Largely as a result of this there was almost a thirty-five-fold increase in the Chinese population of Malacca in the ninety-four years between 1817 and 1911. The numbers of new arrivals are not known, primarily because the Chinese immigrants into Malacca disembarked at Singapore, where they were counted among the immigrants into that State.

The majority of the Chinese in Malacca were engaged in mining, tapioca and gambier planting or trade, and later rubber cultivation. Their distribution within the State was closely allied with these economic activities. In the eighteen-nineties and early nineteen-hundreds many of the Chinese were within, or close to, Malacca town itself, although considerable numbers were also found in Mukims Durian Tunggal, Padang Sebang and Jasin, where tapioca planting was a paying proposition (Figs. 2D and 3D).

The introduction of rubber did not bring about any revolutionary changes in the pattern of population distribution, as most of the estates were established along existing lines of communication, and adjoining to areas where the Chinese were already present in their gambier and tapioca holdings. Its establishment, however, did lead to a 'fanning out' of the population by 1911 when there were already 5,241 Chinese rubber planters in the State (Fig. 4) (44d). Population density was highest in the Malacca Municipality area, which was also the area with the greatest concentration of Chinese in the State. The density of population here was 2,402 persons per square mile in 1891, 2,440 in 1901 and 3,658 in 1911. Several other areas of high density, such as Mukims Klebang Besar, Klebang Kechil and Ujong Pasir were also close to Malacca town. Durian Tunggal, the tapioca and gambier growing area, also had a high density but it was further away from the town (Figs. 2E, and 3E).

The Chinese were present in large numbers where their special economic enterprises, such as trade, mining and commercial agriculture, were predominant. Thus, 51 per cent of the population of the town of Malacca in 1891 was Chinese, and by 1901 and 1911 it had increased to 55 and 60 per cent respectively. In 1911 the Chinese numbered 12,802 out of a total population of 41,191 in the Municipality (42b, 43b, 44b). In other areas where the main economic activity was tapioca or gambier planting — almost exclusively Chinese enterprises — the proportion of Chinese to the total population was even higher. For example, in Mukim Machap the Chinese formed 74 per cent of the total population in 1891. By this time the Chinese were present in all the mukims of Malacca with the exception of Tanjong Rimau — a Malay area in which there was little new land available. Their proportion to the total population, however, varied from 0.05 per cent in Mukim Ramuan China Ketchil to 74 per cent in Mukim Machap. The proportion was continually fluctuating due to the mobility of the Chinese tapioca and gambier

planters, who kept shifting from one locality to another in search of new land. For example, an extension of tapioca and gambier planting in Mukims Tebong and Sebatu resulted in the Chinese proportion of the population rising to 66 and 73 per cent respectively by 1901, but this was at the expense of Mukim Machap where the proportion fell from 74 per cent in 1891 to 28 per cent in 1901 (Figs. 2c and 3c). This was the state of affairs prevailing in Malacca when the First World War broke out in 1914.

THE ESTABLISHMENT OF RUBBER, THE MODERN DEVELOPMENT OF MALACCA AND CONSEQUENT CHANGES IN THE POPULATION STRUCTURE, 1914 TO 1941

The year 1914 is somewhat of a land mark in the history of Chinese migration to Malaya. Not only was it the year of the outbreak of the First World War, but it also marked the abolition of the notorious 'Credit Ticket System' of labour recruitment, and the removal of most of the abuses and obstacles associated with Chinese immigration (106). The period after 1914 was also remarkable in that, while the tapioca and gambier enterprises gradually faded away from the landscape, rubber became firmly established in Malacca (Fig. 6A and 6B) so that the area under this crop increased from 95,000 acres in 1921 to 194,295 in 1937 (107). Together with this economic development the Chinese population of Malacca continued to grow. Though characterized by fluctuations, it increased by 29.1 per cent during the 1911-21 inter-censal period, and by 42.4 per cent and 40.9 per cent during the 1921 - 31 and 1931 - 41 decades respectively (Table 3).

TABLE 3: THE CHINESE POPULATION OF MALACCA, 1921 TO 1941 (108a, 45b, 31d)

	1921	1931	1941
Chinese Population	45,768	65,302	92,125
Total Population	153,522	186,877	236,087

Although natural increase was becoming important, in response to improved sex ratios, the growth of the Chinese population was still largely due to immigration. Also, since the migrational flow was dependent upon economic and political conditions both in China and Malaya the rate of growth varied. For example, immediately prior to 1914 Chinese immigration into Malaya was brisk; 762,477 entered the country between 1911 and 1913 (108b). But the outbreak of war threw great numbers of them out of employment, due to the dislocation of trade and the stoppage of new development projects on newly opened rubber estates. So many were unemployed that they constituted a menace to the security of the country and large numbers were repatriated by the Malayan Government. Immigration was totally prohibited between August 1914 and the end of March 1915. The flow of immigrants once stopped was not easily revived. Thus between 1918 and 1919 Chinese immigrants into Malaya numbered only 129,332 compared with 300,000 per annum during the 1911 - 13 period. This was chiefly because of the rise in the price of silver. As nearly all Chinese immigrants remitted money to their homes in China, the high wages paid in Malaya lost their attraction when the value of the Straits dollar was reduced to only one-third of the Hong Kong dollar. Further-

more, the rice shortage immediately after the war, and the rationing of supplies, tended to restrict immigration (103b). However, bad as conditions were in Malaya in the early nineteen-twenties, following the 1920 - 22 depression and consequent drop in the price of rubber, they were better than those prevailing in South China, and Chinese arrivals were numerous until the late nineteen-twenties (45c). By 1931 the economy of Malaya was in poor shape, due to the world-wide slump and a catastrophic fall in the price of rubber — in the production of which nearly a third of the working population of the country was then engaged (109a, 110). This fact, combined with the relatively low price of tin, resulted in wide-spread unemployment and a considerable exodus of Chinese from Malaya (103c). Between 1931 and 1933, the number of Chinese in Malaya decreased by 273,000 (109b).

The economic, and, with it, the migrational tide turned in 1934-35 as the price of both tin and rubber rose. But in 1936 the net annual migrational surplus fell again following the restriction on rubber production imposed by the Stevenson Scheme (103d, 111). In 1937, however, there came a great forward leap, in step with the increased production of rubber and the accompanying rise in wages. But once again, from 1938 onwards, the flow of immigrants fell sharply as a result of the implementation of a quota, varying from 500 to 6,000 persons per annum, depending upon the country's labour needs. This quota was first imposed in 1933 to control Chinese male immigration, but by 1938 it applied to all categories of Chinese immigrants, both male and female.

All through these years the official policy was to improve the sex ratios among the Chinese, with a view to stabilizing the population. Accordingly there was no limit to the number of Chinese women who could enter Malaya until 1938. The Aliens Ordinance of 1933, introduced to 'regulate the admission of aliens in accordance with the political, social and economic needs for the moment of the various administrations of Malaya', imposed a quota only on Chinese male immigration. This encouraged women in China to emigrate. In addition, female emigration was stimulated by the ticket brokers at the Chinese ports insisting that for each male quota ticket three or four non-quota tickets for females should be bought. As a result, from 1933 until May 1938, when a quota of 500 entries per month was introduced for women, shiploads of Chinese women, chiefly Cantonese, came to Malaya. Their ages ranged between eighteen and forty years and they invariably claimed to be widows. In some cases the custom of the husband emigrating and sending money back to China for the support of his wife and family was probably reversed — the wife now emigrating to earn money for the family in China. Separate figures are not available for Malacca, but for Malaya as a whole there was a migrational gain of 190,000 Chinese women during the 1934 - 38 period (109c). The majority of the women were peasant workers who entered the rubber, tin and building industries and the factories. Most of them married and settled in Malaya. Some *laukehs,*[1] who had worked off their debts, returned to China and married, bringing their wives back with them. Others sent wedding money to their parents in China to pay for a girl whom they considered suitable to marry their son in Malaya. Thus, an ever increasing number of Chinese women came to Malaya and reared families, with the result that the sex ratios improved considerably. By 1931 there were 536 females for every 1,000 males in the Chinese population of Malacca, compared with 486 females per 1,000 males for the country as a whole (109d). The outcome of this was that natural increase became an important factor, especially after the nineteen-twenties. For example,

1. *Laukeh,* a Chinese colloquial term for a person who had lived in *Nanyang* for some time, and had passed the *sinkeh* stage.

by 1931 the proportion of locally born Chinese in the total Chinese population of Malacca was as high as 35 per cent (109e).

The distributional pattern of the Chinese in Malacca during this period did not show any marked changes, except that the traditional tendency to huddle together became more pronounced. Thus, by 1921 no fewer than 48 per cent, that is 21,641 Chinese, were dwelling in settlements of 1,000 or more persons; 98 per cent of these were in Malacca town itself (108c). As their numbers in the towns grew, so large groups of Chinese began to settle on the outskirts as farmers, supplying vegetables, fruit, poultry and pigs for sale in the towns. Further away, in the interior of the State, they tended to spread out along lines of communication, mainly in the rubber growing area (Figs. 5, 6B and 6D).

Malacca town, with a density of 5,931 persons per square mile in 1921, was still the densest concentration of Chinese in the State. Their lowest densities were in the Alor Gajah District, where their numbers had somewhat decreased following the disappearance of tapioca and gambier, and the recruitment of Indian labour in place of Chinese on some rubber estates (Fig. 6E).

The Chinese, being the principal traders of the State, formed the largest proportion of the urban population. Most of the towns of Malacca owe their origin to the Chinese, who formed 65 and 67 per cent of the total urban population of the State in 1921 and 1931 respectively. Their largest numbers were within the municipality of Malacca, where they constituted 70 per cent of the total population (45d). But, despite the tendency to concentrate in urban centres, the Chinese were gradually becoming ubiquitous throughout the State. By 1931 there was no mukim without some Chinese residents (Fig. 6C).

THE JAPANESE OCCUPATION, AND SHIFTS IN POPULATION, 1942 TO 1945

The Japanese Occupation of Malaya during the Second World War saw the rise of a number of new forces, largely economic and political, which brought about significant changes in the pattern of population.

At the time of the Japanese attack on Malaya both the rubber and tin industries were working at maximum capacity. But by 1943 the Japanese had insufficient ships to take away the rubber, and their efforts to distil it into motor fuel failed. Rubber became almost unsaleable. The tin dredges were either sunk or out of action for want of spares. Many workers lost their means of livelihood. At the same time the price of food soared high. Former sources of food — Indonesia, China, Thailand and Australia — were now closed. The people of Malaya realized that the only hope of survival lay in the cultivation of their own foodstuffs. Their efforts in this direction, however, were only partly successful and the loss of life through malnutrition was considerable.

There were other adverse factors which aggravated the food shortage and caused abnormally high death rates, particularly amongst the very young and the old. The Japanese rationing system failed to operate effectively outside the larger towns and villages, resulting in an inflation of the prices of basic commodities, whilst 'black-marketing' became an established mode of business. Worse still, many families lost their bread-winners through the forced recruitment of able men into labour gangs for various Japanese constructional projects, such as the notorious Siamese Death Railway. Added to these difficult economic conditions was the political persecution of the Chinese by the Japanese. Large numbers of Chinese, particularly those between the ages of 20 and 35, were killed by the Japanese (112).

Many villages were destroyed and thousands of Chinese were moved from one area to another, where it was hoped they would be powerless to cause trouble. Many young Chinese left their homes for the jungle to join the Communist-led guerilla forces operating under the name 'The Malayan Peoples' Anti-Japanese Army'. No separate details are available for Malacca, but the combined effect of all the factors mentioned above was that the number of deaths increased and births decreased. This trend was not reversed until after the Japanese surrender in 1945.

The distributional pattern of the Chinese population within the State of Malacca also underwent significant changes. In the first place the search for food and the generally difficult living conditions in the towns obliged a great number to leave the urban areas for the suburbs and the country-side. Since many of these did not own land in the country, 'squatting' (temporary illegal settlement on vacant land) became the standard method of occupying a piece of land for cultivation. Secondly, with the collapse of the rubber industry there was a general exodus from the rubber areas, and a corresponding increase of population in the food producing areas, particularly on the outskirts of towns where markets were within easy reach. The clustering of people around urban areas was a marked feature of the Japanese Occupation.

POST-WAR MALACCA AND THE STABILIZATION OF THE CHINESE POPULATION, 1945 TO 1957

Under normal circumstances it is probable that the Chinese population of Malacca would have exceeded 112,000 by 1947, but instead it numbered only 96,144 persons. This represented an increase of only 4.3 per cent over the 1941 - 47 period, compared with an increase of 41.3 per cent for the preceding ten years — a grim reminder of the great loss of life during the Japanese Occupation. After 1947, with the return to normal conditions and the rehabilitation of the rubber industry, the rate of population growth revived, with an increase of 25.6 per cent during the decade 1947 - 57 (Table 4) (113). These over-all figures, however, do not tell the whole story. In some mukims there were phenomenal increases and in others big decreases. For example, Mukims Chinchin and Blimbing showed increases of 164 and 213 per cent over the 1931 - 47 and 1947 - 57 inter-censal periods respectively, whereas in Mukims Ayer Panas and Sungei Petai there were decreases of 42 and 85 per cent respectively over the same periods (Figs. 7B and 8B) (45e, 109f, 114a). Such changes in the Chinese population were linked with the

TABLE 4: THE CHINESE POPULATION OF MALACCA 1947 AND 1957

	1947	1957
Chinese Population	96,144	120,759
Total Population	239,356	291,211

movement of squatters from one locality to another in search of new lands for settlement and cultivation. In some areas these changes resulted from the resettlement of rural dwellers, principally squatters, as a part of the Emergency

programme.[1] In others the changes were due to Chinese leaving the predominantly Malay areas for the dominantly Chinese localities in search of security, following a deterioration in Sino-Malay relations and the out-break of violence in the interim period between the Japanese surrender and the British re-occupation of Malaya in 1945.

Natural increase, rather than migrational surplus, has been the dominant factor in the growth of the Chinese population during the post-war period (109g). With the establishment of a Communist regime in China and the imposition, in 1953, of severe restrictions on the entry of aliens into Malaya, migration from China to Malaya has virtually ceased (115). In fact the trend of migration in the early post-war years was towards China (116, 117).

As a result of the large scale Chinese female immigration, just before the Second World War, the sex ratios among the Chinese improved tremendously, so that by 1957 there were 952 females to every 1,000 males. Among certain linguistic groups, such as the Cantonese, there were more females than males by 1947. This facilitated the establishment of more homes and a marked increase in the natural growth of population, which was large enough to compensate for the virtual cessation of immigration. Thus by 1957 no less than 66 per cent of the Chinese population in Malacca were locally born, compared with only 35 per cent in 1931. A further 11 per cent were born in other parts of Malaya (109h, 114b).

The post-war period also witnessed a number of changes in the distributional pattern of the Chinese population. The sum of all these movements was that by 1947 the distribution of the Chinese population had largely reverted to the pattern existing before the Japanese invasion. Most people returned to their original occupations and homes, though some of those who had given up tin mining, rubber-tapping or work in the towns for vegetable growing and pig rearing, finding these profitable, remained where they were. The largest numbers of Chinese were found (i) along roads and railways, especially in the rubber areas; (ii) in the food-producing peripheries of towns and (iii) in the towns themselves, which contained 47 per cent of the total population of Malacca in 1947 (Figs. 7A and 7D) (109i). This high ratio of urban dwellers in the Chinese population was further increased following the declaration of the Emergency in 1948.[2]

The nation-wide campaign against the Communist bandits necessitated the movement of some 580,000 rural dwellers, principally Chinese squatters, into 536 nucleated settlements called 'New Villages' located along the main roads for convenience of administration, access and supervision (118, 119). As the majority of the Chinese squatters were in western Malaya this measure accentuated the existing pattern of urban concentration in the rubber and tin belt, which already had most of the towns and 90 per cent of the urban population of the country. Resettlement, together with the natural growth of population, increased the number of urban centres from 187 to 444 and the proportion of urban dwellers in the total population from 35.1 to 47.6 per cent between 1947 and 1957, making Malaya the second most urbanized country in Asia (120). In the State of Malacca 7,725 Chinese rural dwellers were resettled in sixteen New Villages (Fig. 8D) (121). Numerous others, on tin mining areas and rubber plantations, were re-grouped, or

1. See below.

2. A state of emergency, popularly referred to as 'The Emergency', was proclaimed on 16th June 1948 following the discovery of a Communist plot to overthrow the Government. The Emergency ended twelve years later — on 31st July 1960.

transferred from scattered locations to central defended points within the mines and plantations. These military measures practically eliminated the dispersed Chinese peasant farmers from the landscape, though they did not, to any great extent, increase the urban element of the Chinese population, which in 1957 amounted to 52 per cent — only 4 per cent more than in 1947. However, these percentages may be misleading as all the resettlement villages, except Machap Umboo, contained less than 1,000 settlers and were therefore not counted in the urban population. If the Chinese in these centres, together with those clustered in the food producing areas on the peripheries of towns were to be included in the urban population then the proportion of this element in the total Chinese population would be near 70 per cent — probably a more accurate picture of the high degree of nucleation amongst the Chinese in Malacca (Figs. 8A and 8D) (114c).

The areas with the highest population densities were still the Malacca Municipality and the adjoining mukims. Merlimau and Pulau Sebang were the only other mukims to show densities higher than 300 persons per square mile in the post-war period. Merlimau had a big influx of Chinese squatters during the Japanese Occupation, but following the proclamation of the Emergency many of them were resettled elsewhere and others left for their original homes, thereby reducing the number of Chinese in that mukim. Pulau Sebang, once the scene of large scale Chinese tapioca and gambier planting, retained its importance as a predominantly Chinese settlement due to the development of the rubber industry. By way of contrast, the north-western mukims of the State have remained areas with low Chinese population densities, largely because they are traditionally Malay regions and are somewhat inaccessible (Figs. 7E and 8E).

The proportion of the Chinese in the total population continued to be highest in the towns and in the newly developing areas, like Mukims Melekek and Machap, where they formed a substantial portion of the pioneer settlers. The towns continued their trend of becoming more and more Chinese, and by 1957 seventy-five per cent of the urban population in Malacca was Chinese (Figs. 7C and 8C) (114c).

CONCLUSION

Whilst Penang was still only an anchorage and Singapore a fishing village, Malacca was already a focus of the East and a name famous in history and legend. But, while the former became unrivalled entrepôts of the South-east Asian region, Malacca dwindled into relative insignificance. Such was the situation in the middle of the nineteenth century after which time the State's fortunes revived to some extent. As the focus of attention shifted from the port to its hinterland, so the virgin jungle was transformed into a highly developed agricultural landscape of inter-locking cash and subsistence economies, with immigrant and indigenous peoples all linked together and serviced by a network of communications together with marketing and distributing points (Figs. 8A and 9B). In this metamorphosis, the Chinese played a leading role, for they were the pioneers in trade, agriculture, mining and industry. They laid the foundations of the towns of the State of Malacca and cultivated the first tapioca, gambier, pepper and rubber plantations which brought new life to the State. At the same time trading and mining settlements elsewhere in Malaya were often developed by Chinese from Malacca, many of whom later retired to Malacca.

From a few hundred itinerant merchants and craftsmen the Chinese of Malacca increased their numbers, through migration in the earlier phases and later by

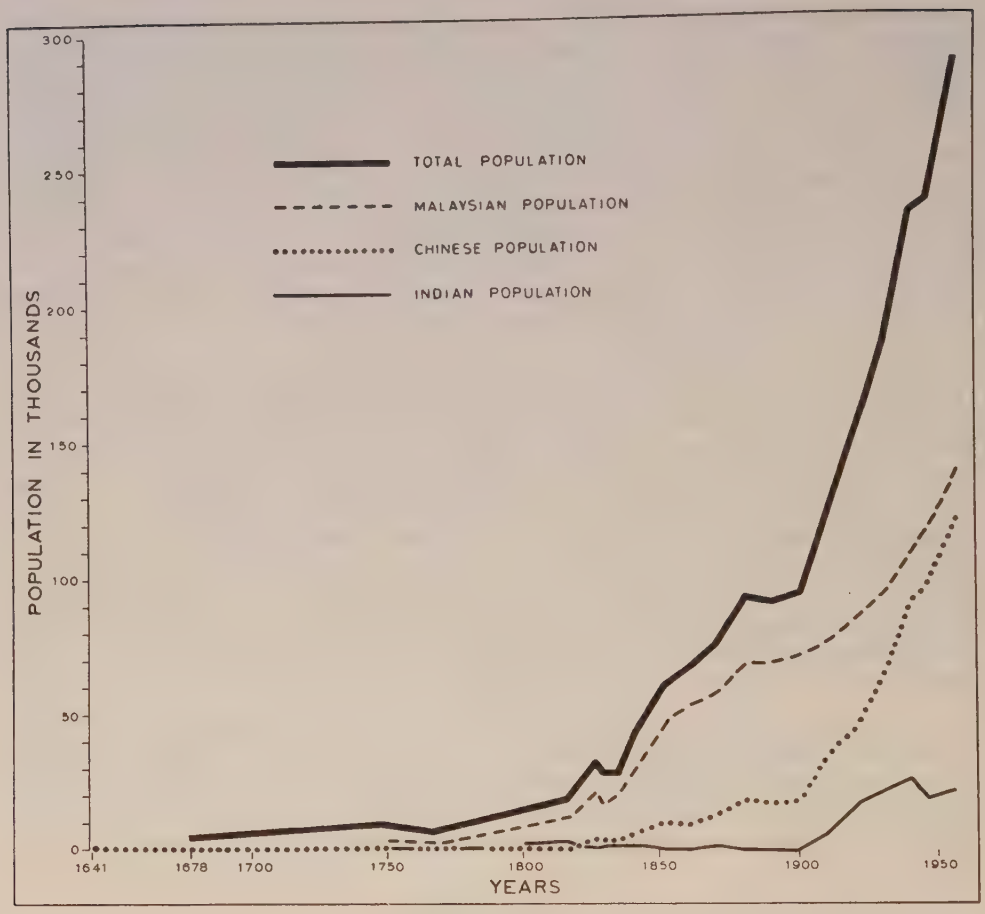


Fig. 10. Growth of the Chinese population of Malacca, 1641 to 1957.

natural increase, to 120,759 out of a total population for the State of 291,211 in 1957 (Fig. 10). More than 45 per cent of the present population is below fifteen years of age and at the current rate of increase it is expected to pass the 200,000 mark within the next two and a half decades (114d). Furthermore, unlike the transient character of the earlier population, the major portion of the present Chinese population of Malacca is highly stabilized and locally born. There is no reason why this trend should not continue, especially in view of the virtual cessation of immigration and the balancing of sex ratios.

The same, however, cannot be said of the distributional pattern, for, with the exception of their traditional concentrations and predominance in the urban centres, the number of Chinese in the other areas has been constantly changing. Intent on quick returns, they have either followed opportunity wherever it beckoned, or, as in recent times, they have been forced to shift by the Government's Emergency resettlement scheme. The distributional pattern of the Chinese is likely to be further modified as the Government's programme to give land to the landless farmers is put into effect (122). Concurrent with this there will be changes in

the densities of the Chinese rural population and in their proportions to the total population, though it is unlikely that their numerical predominance in the urban areas will ever be challenged.

Summarizing, it may be said that Malacca represents an outstanding example of changing values and a humanized landscape, with historical associations stretching over several centuries, in the moulding of which the Chinese colonization of the territory has been a powerful factor.

REFERENCES AND NOTES

Abbreviations

A.R.S.S., Annual Report of the Straits Settlements (Singapore).
A.R.C.P.S.S., Annual Report of the Chinese Protectorate, Straits Settlements (Singapore).
A.A.A.P.S.S., Annals of the American Academy of Political and Social Science (Philadelphia).
B.I.S.A., Bulletin of the Institute of South-east Asia (Singapore).
C.R., The Chinese Repository (Canton).
C.S.P.S.R., The Chinese Social and Political Science Review (Shanghai).
F.E.Q., The Far Eastern Quarterly (New York).
J.I.A., Journal of the Indian Archipelago (Singapore).
J.R.A.S.S.B., Journal of the Royal Asiatic Society, Straits Branch (Singapore).
J.M.B.R.A.S., Journal of the Malayan Branch of the Royal Asiatic Society (Singapore).
L.C.P.S.S., Legislative Council Proceedings, Straits Settlements (Singapore).
M.J.T.G., The Malayan Journal of Tropical Geography (Singapore).
R.C.S.S., Report on the Census, Straits Settlements (Singapore).
S.F.P., The Singapore Free Press (Singapore).
S.S.B.B., Straits Settlements, Blue Book (Singapore).
T.P., T'oung Pao (Leiden).

1. Wang Ta-yuan, *Tao i chih lioh (Description of the Barbarians of the Isles)*, compiled in 1349, p. 16. English translation incorporated in W.W. Rockhill, 'Notes on the relations and trade of China in the Eastern Archipelago and the coast of the Indian Ocean during the fourteenth century', *T.P.*, Vol. 16, 1915, pp. 61-159.
2. Purcell, V., *The Chinese in Southeast Asia* (London, 1951), p. 282.
3. Wheatley, P., 'Chinese Sources for the Historical Geography of Malaya before A.D. 1500', *M.J.T.G.*, Vol. 9, 1958, pp. 72-8.
4. Groeneveldt, W. P., *Notes on the Malay Archipelago and Malacca, compiled from Chinese sources* (Batavia, 1876), (a) p. 1; (b) pp. 124-5 and 134; (c) p. 125; (d) p. 127; (e) pp. 123-34.
5. Purcell, V., 'Chinese Settlement in Malacca', *J.M.B.R.A.S.*, Vol. 20, Pt. 1, 1947, (a) p. 115; (b) p. 117; (c) p. 123; (d) pp. 116-18; (e) p. 119.
6. Cortesão, Armando (ed.), *The Suma Oriental of Tomè Pires*, Vol. 2 (The Haklyut Society, London, 1944), (a) p. 237; (b) pp. 286-7.
7. Wheatley, P., '"A city that was made for merchandise", The Geography of Fifteenth Century Malacca', *B.I.S.A.*, Vol. 1, 1959, (a) p. J.1; (b) p. J.2.
8. de Albuquerque, Braz, *The Commentaries of the Great Afonso de Albuquerque*, Vol. 3. English translation by Walter de Gray Birch (Haklyut Society, London, 1880), (a) p. 118; (b) pp. 87-8; (c) pp. 78-9; (d) pp. 97-100.
9. di Varthema, Ludovico, *Travels* (Haklyut Society, London, 1863), p. 225.
10. Scrivenor, J. B., 'The Geology of Malacca', *J.M.B.R.A.S.* Vol. 5, Pt. 2, 1927, pp. 278-87.
11. de Barros, Joao, *Asia* (Lisbon, 1777-88), Decade 2, Book 6, ch. 1.
12. Hall, D. G. E., *A History of Southeast Asia* (London, 1955), pp. 180-5.
13. Wilkinson, R. J., 'The Malacca Sultanate', *J.M.B.R.A.S.*, Vol. 13, Pt. 2, 1935, pp. 23-6.
14. Winstedt, R. O., 'A History of Malaya', *J.M.B.R.A.S.*, Vol. 13, Pt. 1, 1935, pp. 40-59.

15. Yeh Hua Fen, the Rev., 'The Chinese of Malacca', *Historical Guide of Malacca* (Singapore, 1936), (a) pp. 72-7; (b) p. 74; (c) p. 79; (d) pp. 75-6; (e) p. 83.
16. Fei Hsin, *Hsing ch'a sheng lan (Description of the Starry Raft)*, compiled in 1436.
17. Ma Huan, *Ying yai sheng lan (Description of the Coasts of the Ocean)*, published in 1451.
18. Hwang Chung, *Hai yu (News of the Sea)*. Though published in 1537 this work refers to a much earlier period, certainly before the Portuguese capture of Malacca.
19. *The Malay Annals* (English translation by J. Leyden, London, 1821), pp. 173-85.
20. Cardon, Fr. F. the Rev., 'Portuguese Malacca', *J.M.B.R.A.S.*, Vol. 12, Pt. 2, 1934, (a) pp. 3-4; (b) p. 9.
21. Dubs, H. H., 'The Reliability of Chinese Histories', *F.E.Q.*, Vol. 6, 1946, pp. 23-43.
22. Correa, Gaspar, *Lendas da India* (Lisbon, 1858), Tome II, Pt. I, ch. 29.
23. de Eredia, Emanuel Godinho, 'Declaracam de Malacca e India Meridional com o Cathay', English translation by J. V. Mills, *J.M.B.R.A.S.*, Vol. 8, Pt. 1, 1930, (a) pp. 1-288; (b) p. 19.
24. Pires, Tomè, *Suma Oriental*, Sixth Book, Fol. 166v.
25. Macgregor, I. A., 'Notes on the Portuguese in Malacca', *J.M.B.R.A.S.*, Vol. 28, Pt. 2, 1955, p. 25.
26. McNair, H. F., *The Chinese Abroad* (Shanghai, 1924), (a) p. 53; (b) p. 13.
27. 'Commissary Justus Schouten's Report on his visit to Malacca in 1641', translated by Mac. Hacobian, *J.M.B.R.A.S.*, Vol. 16, Pt. 1, 1936, (a) pp. 113-32; (b) pp. 113-16; (c) pp. 116-32; (d) pp. 133 ff.
28. 'Barreto de Resende's Account of Malacca: 1636'. English translation by G. Maxwell, *J.R.A.S.S.B.*, No. 60, 1911, pp. 1-24.
29. Shellabear, W. G., *The Chinese in Malaysia*, quoted in V. Purcell, *The Chinese in Malaya* (London, 1948), p. 19, footnote 3.
30. 'Report of Governor Balthasar Bort on Malacca: 1678', translated by M. J. Bremmer, *J.M.B.R.A.S.*, Vol. V, Pt. 1, 1927, (a) pp. 32-42; (b) pp. 107 ff; (c) p. 115.
31. Purcell, V., *The Chinese in Malaya* (London, 1948), (a) p. 30; (b) p. 11; (c) p. 8; (d) p. 296.
32. 'Annual Retrospective for 1853', *S.F.P.*, 6.1.1854.
33. Lim Joo Hock, 'Chinese Female Immigration into the Straits Settlements, 1860-1901', unpublished B.A. Honours Thesis (Department of History, University of Malaya, Singapore, 1952), p. 9.
34. Braddell, T., *Statistics of the British Possessions in the Straits of Malacca* (Penang, 1861), Table I.
35. Boulger, D. C., *Life of Sir Stamford Raffles* (London, 1897), p. 65.
36. Newbold, T. J., *British Settlement in the Straits of Malacca* (London, 1839), Vol. 1, (a) p. 136; (b) pp. 136-7; (c) p. 172.
37. Crawfurd, J., *History of the Indian Archipelago* (Edinburgh, 1820), Vol. 1, pp. 134-5.
38. Ward, T. M. and Grant, J. P., *Official Papers on the Medical Statistics and Topography of Malacca and Prince of Wales Island and the Prevailing Diseases of the Tenasserim Coast* (Penang, 1830), Section 1, pp. 2-3.
39. Gullick, J. M., 'Sungei Ujong', *J.M.B.R.A.S.*, Vol. 22, Pt. 2, 1949, p. 19.
40. *S.S.B.B.*, 1871, (a) p. P33; (b) p. y10; (c) pp. x4, x5 and y10; (d) p. u171.
41. *S.S.B.B.*, 1881, (a) p. P33; (b) pp. x4, y6; (c) p. u164.
42. Merewether, E. W., *Report on the Census of the Straits Settlements, 1891* (Singapore, 1892), (a) p. 135; (b) Tables 7-13.
43. Innes, J. R., *Report on the Census of the Straits Settlements, 1901* (Singapore, 1901), (a) p. 125; (b) Tables 13-17.
44. Marriot, H., *Report on the Census of the Straits Settlements, 1911* (Singapore, 1911), (a) p. 9; (b) Table IV; (c) Table V; (d) Table VIII.
45. Vlieland, C. A., *British Malaya: A Report of the 1931 Census* (London, 1932), (a) pp. 105-18; (b) Table 2; (c) p. 113; (d) Table 18; (e) Table 19.
46. *S.F.P.*, 21.9.1837.
47. *S.F.P.*, 9.12.1841.
48. *S.F.P.*, 16.1.1854.
49. *A.R.C.P.S.S.* (1880-1900), incorporated in *A.R.S.S.* (1880-1900), passim.

50. *Ta Tsing Len Lee: Being the Fundamental Laws and a Selection from the Supplementary Statistics of the Penal Code of China,* translated by Sir G. T. Staunton (London, 1810), pp. 543-4.
51. Chen Ta, *Chinese Migrations with Special Reference to Labour Conditions,* Bulletin of the U.S. Bureau of Labour Statistics, No. 340 (Washington, D.C., 1923), (a) p. 18; (b) p. 17.
52. 'Annual Remittance by Chinese Immigrants to their Families in China', *J.I.A.,* Vol. 2, 1847, pp. 35-7.
53. Lang, Olgar, *Chinese Family and Society* (Yale, 1946), p. 10.
54. 'The Tombs of Ancestors', *C.R.,* Vol. 1, Canton, 1833, pp. 499-500.
55. Hu Nai-tsiu, 'Internal Chinese Migration', *Agrarian China* (Secretariat of the Institute of Pacific Relations, London, 1939), p. 256.
56. Middlebrook, S. M., 'Yap Ah Loy', *J.M.B.R.A.S.,* Vol. 24, Pt. 2, 1951, p. 21.
57. Vaughan, J. D., *Manners and Customs of the Chinese of the Straits Settlements* (Singapore, 1879), p. 9.
58. *A.R.C.P.S.S.* (1888), pp. 14-18.
59. 'Notices of Penang', *J.I.A.,* Vol. 6, 1852.
60. Latourette, K. S., *A History of the Christian Missions in China* (London, 1929), pp. 449-62.
61. *S.F.P.,* 27.1.1889.
62. Pyau Ling, 'Causes of Chinese Emigration', *A.A.A.P.S.S.,* Vol. 39, 1912, p. 75.
63. Taylor, G. E., 'The Taiping Rebellion: its Economic Background and Social Theory', *C.S.P.S.R.,* Vol. 16 (Peking, 1933), (a) pp. 549-76; (b) p. 551.
64. Morse, H. B., *International Relations of the Chinese Empire,* Vol. II (Shanghai, 1918), p. 398.
65. Gardener, C. T., 'Amoy Emigration to the Straits', *S.F.P.,* 31.8.1897.
66. Duyvendak, J. L. L., 'Chinese in the Dutch East Indies', *C.S.P.S.R.,* Vol. 11 (Peking, 1927), pp. 1-15.
67. Chen Han Seng, 'The Present Prospects of Chinese Emigrations', in I. Bowman (ed.), *Limits of Land Development* (New York, 1937), p. 138.
68. Gibson-Hill, C. A., 'Steamers employed in Asian waters, 1819-1839', *J.M.B.R.A.S.,* Vol. 27, Pt. 1, 1954, p. 120, footnote 1.
69. Hinton, W. J., *Government of the Pacific Dependencies: British Malaya* (Honolulu, 1929), pp. 127-8.
70. *A.R.C.P.S.S.* (1886), p. 62.
71. Blythe, W. L., 'Historical Sketch of Chinese Labour in Malaya', *J.M.B.R.A.S.,* Vol. 20, Pt. 1, 1947, (a) pp. 69-70; (b) pp. 40-71; (c) pp. 69-103; (d) pp. 86-8; (e) p. 66.
72. *S.F.P. Supplement,* 27.1.1854.
73. *S.F.P.,* 16.4.1863.
74. 'Report of a Commission appointed in 1876 to enquire into the conditions of Chinese Labourers in the Colony', *L.C.P.S.S.* (1876), Paper 22.
75. 'Report of Mr. Pickering on Kidnapping of Sinkehs', *L.C.P.S.S.* (1877), Paper 1.
76. 'Report of the Commissioners of Enquiry into the State of Labour in the Straits Settlements and Protected Malay States, 1890', *L.C.P.S.S.* (1891), Paper 37.
77. *J.I.A.,* Vol. 8, p. 124.
78. Westerhout. J. B., 'Notes on Malacca', *J.I.A.,* Vol. 2, 1848, pp. 171-2.
79. Braddell, T., 'Notes on the Trip to the Interior of Malacca', *J.I.A.,* Vol. 7, 1853, p. 76.
80. 'Tin mines of Malacca', *J.I.A.,* Vol. 9, 1855, p. 120.
81. Blundell, E. A., 'Notes on the history and the present condition of Malacca', *J.I.A.,* Vol. 2, 1848, p. 748.
82. *A.R.S.S.,* 1861, pp. 15 and 41.
83. *A.R.S.S.,* 1862-1863, p. 12.
84. *A.R.S.S.,* 1912, p. 472.
85. *S.S.B.B.,* 1911, (a) pp. x6-x9, (b) pp. w4, w5 and x8-x10.
86. The Chief Geologist in Malacca stated, in a personal note to the author, that tin mining had ceased in that part of Malaya by August, 1960.
87. Balestier, J., 'View of the State of Agriculture in the British Possessions in the Straits of Malacca', *J.I.A.,* Vol. 2, 1848, p. 144.
88. Baumgarten, F. L., 'Agriculture in Malacca', *J.I.A.,* Vol. 3, 1849, p. 707.

89. The Chinese of Malacca not only pioneered the penetration of the interior of the State but also of the adjoining States, such as Negri Sembilan and Selangor. Yap Ah Loy, the founder of Kuala Lumpur, was from Malacca.
90. *A.R.S.S.*, 1861-62, Section IX, p. 31.
91. Logan, J. H., 'Cinnamon Cultivation in the Straits of Malacca', *J.I.A.*, Vol. 5, 1851, p. 650.
92. Low, J., 'Notes on the Progress of the Nutmeg Cultivation and Trade from the early part of the Seventeenth Century up to the Present Day', *J.I.A.*, Vol. 5, 1851, pp. 470-87.
93. Burkill, I. H., 'Pepper, Nutmegs and Rubber', *Malaya*, 1953, (a) pp. 587-9, 647-50; (b) p. 650.
94. *A.R.S.S.*, 1866, (a) pp. 199-200; (b) p. 198.
95. *A.R.S.S.*, 1918, p. 496.
96. By 1891 there were twenty-eight tapioca factories and 63,440 acres under tapioca in Malacca, but by 1911 these figures had dwindled to eight factories and 10,926 acres.
97. *S.S.B.B.*, 1891, pp. x4, x5 and y6.
98. Makepeace, M., et. al. (eds.), *One Hundred Years of Singapore* (London, 1921), p. 80.
99. Burkill, I. H., *A Dictionary of the Economic Products of the Malay Peninsula*, Vol. 2 (London, 1935), p. 2204.
100. Gambier exports in 1912 amounted to M$309,438, compared with M$168,000 in 1917.
101. *The Planter* (Kuala Lumpur, 1921), p. 3.
102. Tan Cheng Lock, *The Malacca Guardian*, 11.2.1935.
103. Mills, L. A., *British Rule in Eastern Asia* (London, 1942), (a) p. 185; (b) p. 189; (c) pp. 241-2; (d) pp. 204-5.
104. Bauer, P. T., *The Rubber Industry, a study in Monopoly and Competition* (London, 1948), p. 14.
105. In 1926 rubber research was made the responsibility of a Government financed institution known as the Rubber Research Institute (R.R.I.).
106. *Annual Report of the Secretary for Chinese Affairs, Malaya, for the year 1939* (Singapore, 1940), p. 1.
107. *A.R.S.S.*, 1937, Vol. 2, p. 404.
108. Nathan, J. E., *Census of British Malaya, 1921* (London, 1922), (a) Table 6; (b) p. 22; (c) Table 11.
109. del Tufo, M. V., *Malaya: A Report on the 1947 Census of Population* (London, 1949), (a) p. 33; (b) p. 597; (c) p. 58; (d) p. 57; (e) pp. 33, 84; (f) Table 5; (g) pp. 83-5; (h) p. 84; (i) Table 7.
110. Grist, D. H., *An Outline of Malayan Agriculture* (Kuala Lumpur, 1936), p. 77.
111. Owing to the general trade depression in 1921 the rubber-producing industry was threatened with ruin. Ultimately, the British Government put into force a scheme — known as the Stevenson Scheme — for restricting the amount of rubber which might be exported. The object was to reduce the difference between production and consumption, thereby facilitating the absorption of the excessive stocks of rubber on the market, and stabilizing the price of the raw material.
112. Smith, T. E., *Population Growth in Malaya* (London, 1952), p. 81.
113. *Settlement of Malacca, Annual Report for 1949* (Johore Bahru, 1950), p. 2.
114. *The 1957 Population Census of Malaya, Report No. 5, Malacca* (Kuala Lumpur, n.d.), (a) Table 3; (b) Table 9B; (c) Table 4; (d) Table 6.
115. *Minutes and Council Papers of the Federal Legislative Council 1953/1954* (Kuala Lumpur, 1954), Papers No. 28 and 29 of 1953.
116. *The Federation of Malaya, Annual Report, 1948* (Kuala Lumpur, 1949), p. 5.
117. *Monthly Statistical Bulletin of the Federation of Malaya, August 1960* (Kuala Lumpur, n.d.), Table 3.
118. Corry, W. C. S., *A General Survey of New Villages: A Report to the High Commissioners for the Federation of Malaya, 12th October, 1954* (Kuala Lumpur, 1954).
119. *Statistical Information Concerning New Villages in the Federation of Malaya* (Mimeo. The Federal Secretary's Office, Kuala Lumpur, 1952).
120. *The 1957 Population Census of the Federation of Malaya, Report No. 1* (Kuala Lumpur, n.d.), Table 3.
121. District Office, Malacca — in a personal communication to the author.
122. Federal Land Development Authority, *No Need to be Poor: A Policy Statement* (Kuala Lumpur, 1956).

RELIEF AND COASTAL DEVELOPMENT IN NORTH-EASTERN JOHORE (MALAYA)

By J. J. NOSSIN

This paper is based on a programme of field work carried out during 1959 and 1960, sponsored by the Department of Geography, University of Malaya in Singapore. It is the author's privilege to acknowledge the assistance in the field of the following students: Miss Tan Lee Kiang, Mr. Ling Chu Poh and Mr. Isher Singh Sekhon. The author wishes to express his thanks to the following for their co-operation: Mr. C. K. Burton (Geological Survey of Malaya, Johore) for information regarding the geology of the area; Mr. Chuah Huat Seng (Public Works Department, Mersing) for providing data on local borings; Professor W. A. R. Wikkramatileke (Department of Geography, University of Malaya in Singapore) for his comments on the manuscript; the District Officer and the Assistant District Officers of Mersing District for numerous facilities during the survey.

INTRODUCTION

THE AREA selected for study lies in the north-eastern part of the State of Johore, Federation of Malaya (Fig. 1). It is a low undulating area bordering the South China Sea, with an average elevation of about 250 feet. The highest point, Bukit Arong, lies at 898 feet above sea level. The area shows an interesting alternation of erosional and depositional land forms. Most of it is under jungle, but the coastal stretch has a number of clearings where observations may be made.

It experiences humid tropical climatic conditions throughout the year with an outstanding rainfall maximum during the north-east monsoon, roughly from November until February (1).

Fig. 1. Location of the area investigated.

GEOLOGICAL SUMMARY

No adequate geological map for the area exists as yet. The latest information available is the 1948 Geological Map of Malaya (2). Figure 2 is a geomorphological map based on the author's field studies; it is also an attempt to visualize the geology of the area as it appears from sample observations.

Pahang Volcanic Series

The solid rocks of the area belong either to the Triassic Quartzite-Shale Series or to the Pahang Volcanic Series. The latter Series is regarded as Permo-Carboniferous (3, 4). Although tuffs of mainly acid and andesitic composition are most common in rocks of the Pahang Volcanic Series in Malaya, this Series in north-eastern Johore consists of rhyolitic rocks. Outcrops occur along the coast between Tanjong Penyabong and Pulau Stindan (compare Figs. 1 and 2). Inland, very few outcrops of this formation can be found, although aerial photographs show clearly the area in which rhyolitic rocks may be expected. Fitch believes that in the Kuantan area, about 110 miles north of the area under consideration, volcanicity occurred during the Visean and during the deposition of the Arenaceous Series (5). The Arenaceous Series there is of Middle and Upper Triassic age, and the volcanic rocks of the same age are rhyolites. It seems justifiable to assume that the rhyolites in north-east Johore are of the same Triassic age as the rocks of the Quartzite-Shale Series.

Quartzite-Shale Series

The Quartzite-Shale Series in the area under study is of Triassic age. The probable extent of this Series is shown in Fig. 2. Along the main road quite a number of exposures were identified, though rock unaffected by weathering was only found in a quarry near Sungei Takadai and in a few sea cliffs. In all roadside outcrops the intensely folded structure of the Series is clearly preserved though the rock itself is much weathered.

Rocks of the Quartzite-Shale Series show alternating beds dominantly of shales together with sandstone or quartzite. The rocks are intensely folded and impregnated with quartz veins varying in thickness from a fraction of an inch to over three feet. The shales are mainly blue-black to grey in colour. In places, where there has been little metamorphism, there are carbonaceous shales and even thin coal seams. No fossils were found in them. In the vicinity of the contact zone between the rhyolitic rocks and the Quartzite-Shale Series, the shales are metamorphosed into schists as shown by the presence of mica fragments in the weathered rock. This metamorphism may serve as an indication that the rhyolites are of the same age as, or even younger than, the Quartzite-Shale Series in the area.

Along the coast the trend of the Quartzite-Shale Series is, in many places, parallel to the present shoreline. At inland outcrops a number of strike and dip measurements show widely differing dips owing to the strong folding of the layers. The general trend is mainly between 120° and 160°.

Younger Igneous Rocks

Near the 104 milestone on the Mersing-Endau road, a small outcrop of younger igneous rocks is found. There are two types, one a medium grained dark coloured rock and the other a coarse granitic rock, probably a normal hornblende granite. These two types occur in various bands, but no detailed determination of the rock type could be carried out. It is probable that this outcrop is an outlier of the main granitic intrusive body of Malaya.

Younger Deposits

The rest of the Mesozoic and probably the whole of the Tertiary are not represented. Pleistocene and younger deposits are found either as marine, fluvial, or swamp deposits. Fossils or other definitive means of dating are lacking. A few borings let down in the area by the Public Works Department in search of groundwater revealed that the thickness of these deposits increases with distance

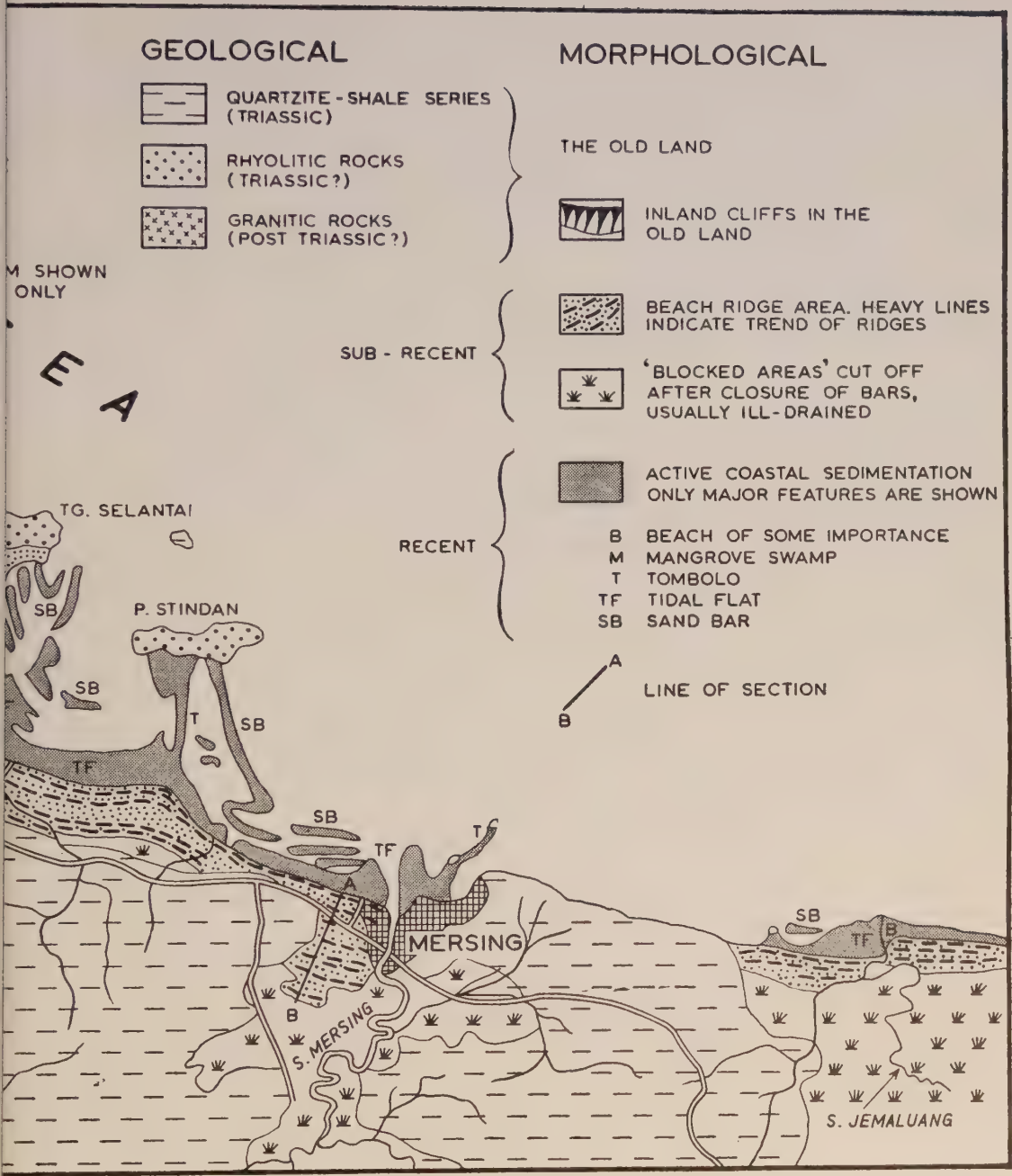
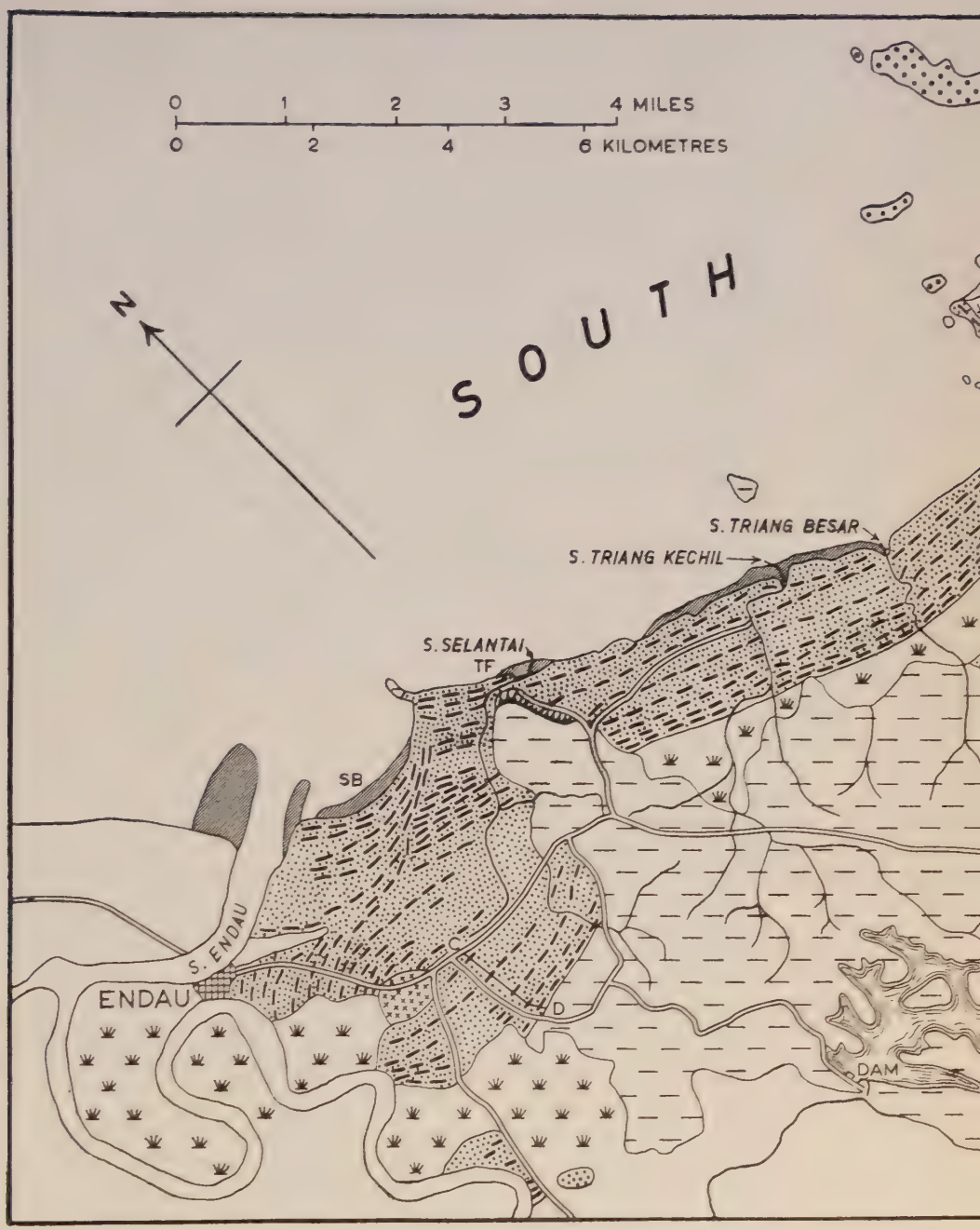

GEOLOGICAL
QUARTZITE - SHALE SERIES (TRIASSIC)
RHYOLITIC ROCKS (TRIASSIC?)
GRANITIC ROCKS (POST TRIASSIC?)
M SHOWN ONLY
E A
SUB - RECENT
RECENT
MORPHOLOGICAL
THE OLD LAND
INLAND CLIFFS IN THE OLD LAND
BEACH RIDGE AREA. HEAVY LINES INDICATE TREND OF RIDGES
'BLOCKED AREAS' CUT OFF AFTER CLOSURE OF BARS, USUALLY ILL-DRAINED
ACTIVE COASTAL SEDIMENTATION ONLY MAJOR FEATURES ARE SHOWN
B BEACH OF SOME IMPORTANCE
M MANGROVE SWAMP
T TOMBOLO
TF TIDAL FLAT
SB SAND BAR
A
B
LINE OF SECTION
TG. SELANTAI
P. STINDAN
SB
T
TF
MERSING
S. MERSING
S. JEMALUANG

Fig. 2. The geomorphology and a sketch of the geology of the Mersing/Endau area.

(Corrigendum: S. SELANTAI about two miles east of the S. Endau outlet should be S. TAKADAI)


0 1 2 3 4 MILES
0 2 4 6 KILOMETRES
N
SOUTH
S. TRIANG BESAR
S. TRIANG KECHIL
S. SELANTAI
TF
SB
S. ENDAU
ENDAU
C
D
DAM

from the Old Land topography. The deepest borings reached forty feet without penetrating the bottom of the sedimentary series. Fitch quotes figures of as much as 169 feet for the total thickness of these sediments in the Kuantan area (5).

PROCESSES OF SCULPTURE

Weathering

Weathering could be observed best in the Quartzite-Shale Series. Under the prevailing climate, weathering is deep and intense. Two zones can be distinguished in the weathering profile of the Quartzite-Shale Series. In the upper six feet or so the rock is weathered beyond recognition into a clayey product, dark red in colour with yellow and orange patches, alternating sometimes with large clear white zones. This upper zone is thinnest on top of the hillocks and increases in thickness irregularly downslope. Since exposures are restricted to the higher parts of the hills, only an estimate can be made as to the thickness of this zone in the lower parts of the slopes. It is probable that it does not exceed thirty feet and that in most cases it will not be more than about eighteen feet. In outcrops along the main road this zone was found to be four to six feet thick in the upper parts of the hillocks. A zone of iron concretions, sometimes several feet thick, is present in most places about three feet below the surface.

A second zone of weathering, very different from the first, is found below the upper zone discussed above. After a rather rapid transition of about six feet the structure of the rocks in the second zone becomes clear in the profile. Though intensely weathered, its association with the parent material and its structural affinities are evident. Here the shales weather to clayey material still showing the shale structure and retaining the original blue-black or grey colour. In the upper part of this zone red staining resulting from the precipitation of iron oxide can be observed in patches through the rock. In this zone, quartzites and sandstones weather to sand and clayey sands, loosely held together and retaining the original structure. Quartz veins weather to a friable mass of fragments which, in the upper part of the second zone, may be red in colour due to iron deposits (6). Only in one place was the unweathered rock of the Quartzite-Shale Series exposed, and it was found that the second zone of weathering with visible structure here reached at least fifty feet below the surface.

Unfortunately no reliable information was available concerning the weathering of the rhyolitic rocks, mainly because of the lack of outcrops in which weathering profiles may be studied.

In the sandy parts of the Younger Deposits soil profiles which have definite podsolic affinities were observed at numerous places. The profile of such a podsolic soil at Kampong Jemaluang Kechil is given below:—

Depth in feet	
0	vegetation; lalang and coconut palms
0-1	dark grey fine sand without shell fragments
1-3	light grey to white leached sand
3-5	slightly cemented fine brown sand rich in iron[1]
5-8	exposure concealed; probable extension of previous horizon
8-?	brown-grey sand, less rich in iron
10-	end of exposure.

1. The presence or absence of precipitated humus could not be ascertained.

Denudation and slope development

Despite the usually high rate of denudation, spectacular earth displacement is not very conspicuous in this area. The local relief is consequently subdued. It is important to note that mass movement is restricted to the upper zone of weathering in the Quartzite-Shale Series, since the lower zone of weathering retains the original rock structure. The increase in thickness of the upper zone down the slope, therefore, may be safely attributed to mass movement and not to more intense weathering. Mass movement may have added to the filling up of valleys. However, it would require more detailed investigation to distinguish properly between fluvial and colluvial valley fillings. No conspicuous damming or blocking of valleys due to landslides were observed. The pattern of mass movement, the strikingly uniform levels and comparatively low relief — with the possible exception of the rhyolitic rock area — give the whole region the characteristics of a 'Doppelte Einebnungsflache', a double planation surface in the sense of Büdel (7), where the contact of weathered and fresh rocks lies far below the zone of mass movements.

Observations of slope profiles were difficult on account of the dense jungle with thick undergrowth. Substantial clearings, however, have been made west of Mersing Air Strip and north of Endau village. Both areas lie in the Quartzite-Shale Series and a few selected slopes were measured in detail. The uniformity of the slopes and the concordant height of the hillocks was very striking, especially in the Endau clearings. The analyzed slopes were measured in the direction of 'true slope', that is perpendicular to the contour lines, by means of taping and levelling with an Abney Level. A stretch of uniform slope angle is termed a slope segment (8). In Figs. 3 and 4 the slope segments of the analyzed slopes, from the two areas mentioned above, are graphically represented. The distance from each point to '0' represents the length of a slope segment, and its angle is represented by the angle of the line which can be drawn from the point to '0'. Segments of several slopes from one geologically and morphologically uniform area are plotted as individual points, thus giving an impression of the general character of slopes in the area concerned. The more irregular form of the slopes in the area west of Mersing Air Strip manifests itself in the shorter

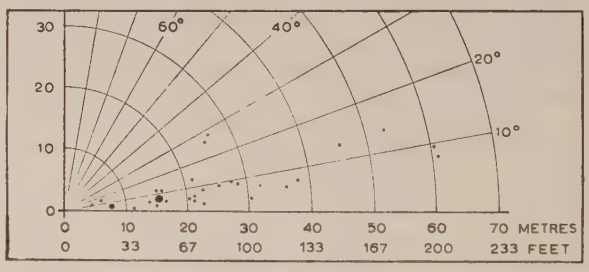


Fig. 3. Graph showing slope segments of an area west of Mersing Air Strip.

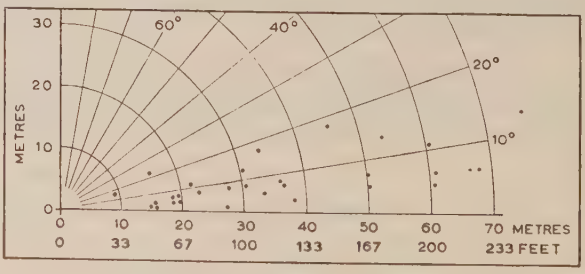


Fig. 4. Graph showing slope segments of an area south of Endau.

length of the slope segments. The general tendency of the slopes is convex. As an illustration, one slope in the Endau clearing is described as follows:

Going upslope from flat valley floor:

Length of segment	*Slope angle*
30 feet	16°
250 »	13°
165 »	7°
165 »	5°
117 »	decreasing to 0° at top.

Assuming that the depth of the upper zone of weathering increases down the slope, then the profile of the contact between the upper and lower zones of weathering must be still more convex. Also, it is probable that the face of the unweathered rock will be more convex than the surface slope.

Coastal erosion and deposition

Erosion. Marine erosion is active where the Old Land[1] abuts onto the sea. Undercutting produces steep and often perpendicular cliffs both in the rhyolite and the Quartzite-Shale Series. Features such as stacks, arches, under-sea cliffs, wave hollows and wave-cut notches are plentiful in these places. The present drainage pattern of the Old Land bordering the sea suggests a considerable recession of the cliffs. Most of the rivulets flowing directly seawards have been cut short and robbed of their lower and middle courses. The local watersheds run close to the coast and most of the area drains inland towards the major rivers. Whether, and to what extent, marine erosion is active on the present clastic sediments, where these form the coast, remains uncertain. Erosion is seemingly more than balanced by coastal sedimentation.

Sedimentation. Coastal sedimentation can be of marine, fluvial or estuarine character. Wave erosion of cliffs mostly attacks unweathered rock, and material so derived will be far less clayey than riverine material. It was noted that sand beaches occupy sheltered places between rock cliffs, and that sand bars grow from exposed capes so as to form a series of spits, tombolos and associated features. From Fig. 2 it is clear that they grow from, and link up, a number of cores—islands, capes and even small stacks and under-water cliffs. New bars grow alongside the older ones so as to form a series of beach ridges; the oldest ridges lie furthest inland.

Once a bar appears above water, submergence at high tide leads to the deposition of coarser sediment only. After it grows above normal high tide level, sedimentation is possible only at storm-tide and consequently the material is still coarser.[2] Wind action also helps to increase the height of beach ridges through the accumulation of fine sand. Though Lobeck states that beach ridges may reach a height of twenty feet above high tide (9), no heights of more than ten feet above high tide were observed in the beach ridges immediately adjacent to the coast.

In the neighbourhood of river outlets, however, large quantities of fluvial clay are supplied. Upon entrance into the sea the whole bedload of the river is deposited; while settling it may be carried over a short distance by the currents. The clay sedimentates in distinct layers and does not mix with the sand. The

1. For explanation of this term see page 33.
2. The sandy material ranges between fine and medium-coarse sand.

result is an alternation of sand and clay layers. The shallowness of the sea and the large supply of material cause the building-up of tidal flats around the many river outlets. These flats sometimes join up, accounting for an extended tidal zone parallel to the coast. Where the clay sheets are exposed to wave action they may produce clay pebbles (10). There is reason to believe that tidal flats and similar coastal deposits underlie the beach ridges at most places. Also it is possible to observe how tidal flats may act as a base on which bars, tombolos, and other features, finally accumulate.

Fluvial modelling

Fluvial erosion. Erosion along the lowlying main channels of the Endau and Mersing rivers is not very significant. Both exhibit meander shifts and both have broken through coastal bars. The two rivers in this coastal sector mainly act as transporting media for the large amounts of clay and silt derived further upstream. Erosion in the smaller catchments of the Old Land is more significant, especially towards the headwaters. The uniformity of relief in the Quartzite-Shale Series and the uniformity of slope development point to the relative importance of mass movement in the process of sculpture with respect to the process of fluvial erosion.

Drainage systems. Figure 2 shows only the main drainage channels. The detailed drainage texture is in fact very fine throughout the upland areas, with a dense network of streams handling a large surface run-off. Free drainage exists only in the higher parts of the Old Land and on most of the beach ridges. The rest of the lowland consists almost entirely of freshwater swamps. The whole of the Endau river plain, the southern part of which is now under drainage control for padi cultivation, is one example. These freshwater swamps have developed where drainage has been impeded by beach ridges formed seawards of the Old Land. Rivers from the Old Land keep such flats almost permanently flooded; in many cases the rivers actually disappear into the swamp, to re-appear at their outlet into the sea. The filling of the swamps with fluvial clays impedes drainage even more.

From Fig. 2 it is evident that most of the discharge in this area is through the basins of minor rivers such as the Sungei[1] Tenglu, S. Mawar, S. Triang Besar and S. Triang Kechil. The eastern part belongs to the S. Endau basin and the southern region drains into the S. Mersing. The Endau and Mersing rivers have maintained their outlets directly through the developing spits and beach ridges. Some of the minor rivers, however, have not been able to do this. They often follow the swale just behind a beach ridge for varying distances. The complex and intricate pattern of drainage here is determined by the relative balance between fluvial erosion and marine aggradation. These two factors obviously have not been constant.

Fluvial deposition. Most of the freshwater swamps are being filled in with heavy clay. The swamp clays are in places rich in organic remains and peat layers occur sometimes. In the absence of organic matter the colour of the clay is blue-grey. In both the fluvial plains and the freshwater swamps the remarkably uniform clays overlie marine or estuarine sediments. It is evident that the present plain of the Endau river is a filled-in estuary which formerly penetrated inland for at least twelve miles. There is little doubt therefore that estuarine deposits underlie the freshwater swamp clays, but at depths which could not be reached with the

1. Sungei means river, abbreviated as S.

field equipment available. In some other places, where the Public Works Department had carried out borings for water prospecting, a clear boundary between fluvial or swamp clays and marine sand was detected.

The Mersing outlet area was likewise an estuary of a much smaller size. Here also there has been a filling in with both fluvial and swamp clays. The riverine material is predominantly clay. It is therefore easy to distinguish in the field between marine sandy deposits and fluvial clays. It is not so easy to distinguish between freshwater and marine-brackish clays. No data for the granulometric composition of the clays are available yet.[1]

PHYSIOGRAPHIC UNITS AND RELIEF DEVELOPMENT

Physiographic Units

From the foregoing it will be clear that the following physiographic units may be distinguished: (a) Old Land; (b) inland beach ridges; (c) freshwater swamps and (d) present coastal forms.

(a) *The Old Land.* All parts consisting of solid rocks, though weathered, are considered as 'Old Land', and are indicated as such in Fig. 2. This comprises the main land mass, several offshore islands and a number of former islands. As pointed out before, a distinction can be made between the relief developed on the rhyolitic rocks and that developed on the Quartzite-Shale Series. In the latter a series of hillocks at an average elevation of 250 feet can be seen. They have strikingly uniform heights in the north, but there is more variation of relief to the south. This area can be considered part of a 'Doppelte Einebnungsflache', a double planation surface in the sense of Büdel (7), as already described. Because of lithological differences, the more resistant rhyolitic rocks seem to stand apart from this unit.

(b) *The inland beach ridges.* The oldest recognizable series of beach ridges lies nearly five miles inland on the Endau plain. However, as far as eleven miles south of Endau, near Sungei Jurak, a sandy deposit with an estimated height of about fourteen feet above sea level may be a remnant of a former beach ridge. This occurrence is not entered in the map and is excluded from the following discussion.

The beach ridges furthest inland have maximum heights of about twenty-five feet above sea level and their elevation decreases steadily in a seaward direction. Two sections across the inland beach ridges were bored and levelled in detail; they are shown in Fig. 5. Section A-B lies in the Mersing area. It shows clearly the sandy character of the ridges and the increasing clay content downwards. The area further to the west, and landward of the ridges, consists mainly of clay, which may be a swamp or estuarine deposit. A patch of sandy clay here suggests the remains of a former beach ridge. The clay continues beyond 'B' in the section, and probably reaches as far as the Old Land (compare Fig. 2). The clay underneath the highest sandy ridge may be the same as the clay further inland, or it may be a tidal-flat deposit. The sand-clay mixtures here are certainly of tidal-flat origin. Section C-D runs from the Old Land seawards in the Endau area, but does not reach the coast. The gravel in the clay-sand mixture can be ascribed to an igneous outcrop in the neighbourhood. The characteristic sandy deposits which overlie the sand-clay mixtures are very conspicuous. The sand-clay mixture itself is probably of tidal-flat origin. In this area especially the tidal-flats were probably estuarine.

1. A sample analysis is being carried out.

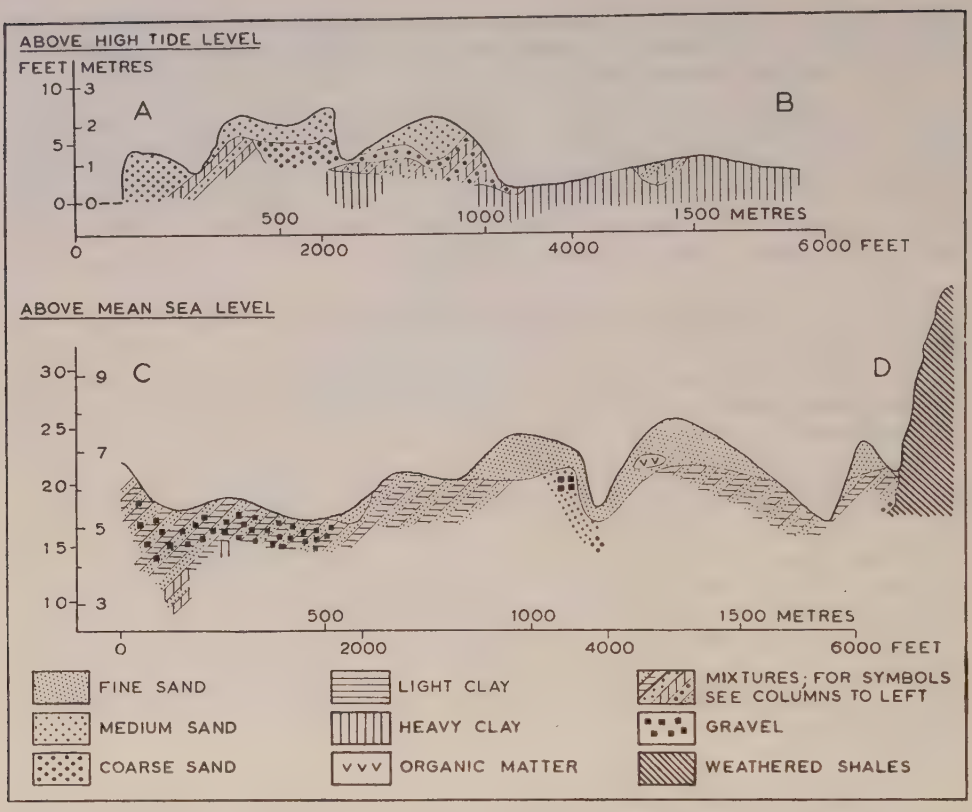


Fig. 5. Bored and levelled sections across the inland beach ridges. For location of the sections see Fig. 2.

(c) *The freshwater swamps (blocked areas).* This category should also include, in addition to the main flats, all those small units which have been pocketed by the formation of beach ridges. In all these areas drainage is partly or fully impeded. Under fully impeded conditions true swamps develop, whilst partly impeded drainage manifests itself in a high ground water-table causing gley phenomena high in the soil profile. In Fig. 2 permanent and temporary swamps and impounded water areas are considered as one unit. The blocked areas vary in their morphological character from a cut-off estuary to a cuspate foreland between bars of complex tombolos.

Characteristic of all these areas is the heavy clay which forms the surface layers. Layers of peaty clay or true peat are sometimes found in borings. The thickest peat layer (four feet) was found on the surface to the south-east of the Endau plain near the Old Land, it may mark a former meander of the Endau river or the course of a former tributary. Other peat layers seldom exceeded sixteen inches in thickness.

For the blocked area south of Mersing information is provided by a few water borings of the Public Works Department. From these records it is apparent that the clay is locally more than thirty feet thick, with the underlying weathered rock coming higher in the profile further to the south, in which direction it finally

reaches the surface. Similar conditions may be expected in other blocked areas where the same heavy clay surfaces occur. Every flood continues the process. In the vicinity of rock capes or inland cliffs the clay is sometimes mixed with coarser fragments up to fine gravel size, as for instance in the Selantai area. Just as with the inland beach ridges, marine deposits may be expected underneath the swamp clays.

(d) *The present coastal forms.* Erosive forms include the cliffs, wave-cut notches, stacks, arcs, capes and so forth. Depositional forms include the tidal-flats, underwater and emerged bars and spits, tombolos in state of formation or just formed, and a few mangrove or tidal swamps. In Fig. 2 only the major depositional coastal features are shown. Tidal-flats are extensive in the bay between Tanjong Selantai and Mersing; they are also important between S. Takadai and S. Triang Besar. Between Tanjong Mawar and the mainland the central part of a tombolo appears just above sea level. A similar feature, still partly submerged, occurs between Pulau Stindan and the mainland. Minor tombolos form links with all kinds of rock stacks and with the mainland at numerous places.

Many of the present beaches are in fact the youngest members-to-be of a series of inland beach ridges. Their development often forces the river outlets to shift in the direction of their growth. Good examples are found at the S. Takadai and S. Triang Kechil outlets. The other coastal depositional forms are simply the products of the same processes which built the inland beach ridges and associated forms.

In the Old Land a number of cliffs can be recognized as former seaboard cliffs which have been protected from further wave action by the outgrowth of beach ridges.

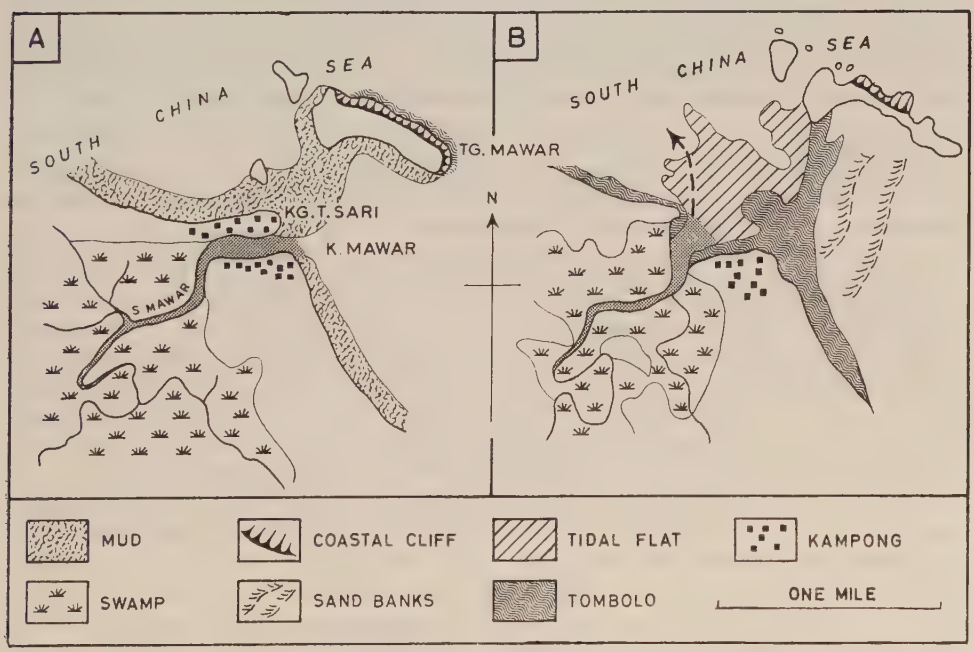


Fig. 6. Coastal changes around the outlet of the Sungei Mawar.
A: situation in 1938 (from topographic map).
B: situation in 1958 (from aerial photographs).

It is interesting to note the comparatively rapid changes in the configuration of the S. Mawar outlet. Figure 6A depicts the situation as shown on the One Inch Topographical Map of Malaya, based on a 1938 survey and published in 1944. Figure 6B represents the situation in 1958 as shown on aerial photographs. The eastern outlet of the S. Mawar has disappeared due to the growth of a tombolo, and the new course of the river has destroyed the former bar on the west. Similar changes continue to modify the detailed appearance of coastal forms. Near the S. Takadai outlet the configuration, as reflected in the location of clay pebbles, changes even from day to day (10).

Relief Development

The rocks of the Quartzite-Shale Series on the east coast of Malaya were probably deposited in the Middle and Upper Triassic. Fitch places the Quartzite-Shale Series in the Kuantan area as such (5), and the same age could reasonably apply to the rocks of this Series in north-eastern Johore. Moreover, rhyolitic rocks of the same age occur in the Kuantan area. The metamorphism of the Quartzite-Shale Series around the rhyolitic rocks in the Mersing-Endau area suggests that the volcanic rocks and the Quartzite-Shale Series are of approximately the same age.

During the Jurassic in the Kuantan area the sediments were consolidated and folded, and it is assumed that the same happened in north-eastern Johore. Similar relationships could be drawn for the Cretaceous granites. In north-eastern Johore the outcrop at the 104 milestone might be an exponent of this.

During the Upper Cretaceous and Lower Tertiary, as well as through the earlier periods, considerable erosion and down-wearing must have taken place, combined probably with tectonic movements of some magnitude. According to Richardson, who tried to trace the geomorphological evolution of Malaya (11), the present drainage system finds its origin in the Cretaceous, but it has since been modified. As for the relief development of the Old Land in north-eastern Johore, it is only possible to suggest that prolonged intense weathering and down-wearing have produced a rather uniform relief, especially in the Quartzite-Shale Series.

During the Pleistocene repeated eustatic movements altered the land and sea configuration of the Sunda platform, and the consequences must be reflected in the geomorphology of Malaya. In the Mersing-Endau area, which is small in this context, no such influences have been found.

The more recent evolution of the area is clearer. The Old Land topography had obviously developed into a mainland core with a number of offshore islands. In view of the present configuration it seems justified to say that this situation developed after the latest post-glacial rise in sea level, which submerged most of Sunda Land. The rise in sea level must have been at least 107 feet — probably much more (5). At the maximum stand of sea level the offshore islands were formed and the principal river mouths became broad estuaries penetrating far inland. This was especially true of the Endau river. A world-wide fall of sea level in recent or sub-recent times was postulated by Daly and has since been widely accepted (12). The amount of fall in sea level would be about twenty feet, with local variations. Before this fall of sea level the former estuaries of the Endau, Mersing and other rivers and the present 'blocked' areas were fully submerged. They are all less than twenty feet above the present-day mean sea level. During the phase of higher sea level, conditions of weathering in the existing Old Land were possibly similar to what they are now. However, the coastal accretion will have been largely facilitated by the subsequent withdrawal of the sea. It seems likely

that the formation of the present inland beach ridges started when the sea level was still some twenty feet higher than it is now. The bars and tombolos thus formed, blocked the estuaries, completely or partly, and connected islands with the mainland, producing the first 'blocked' areas which were liable to rapid filling in. As the sea withdrew more beach ridges were formed and more areas were cut off until the present configuration came into existence.

Apart from the earlier mentioned inland sandy ridge near Sungei Jurak, the oldest beach ridges and the most remote from the sea lie in the Endau plain. In this plain a number of isolated hills are found, consisting of Old Land, and these acted as cores from which the bars and tombolos grew. The mainland formed another point of attachment. The outcrop of igneous rocks south of Endau was only one of these cores, all of which stood as islands in the estuary.

Tanjong Penyabong was probably a peninsula, whereas Bukit Tioman Darat and Tanjong Resang were small isolated islands. The Arong area was a bigger island and Tanjong Selantai must have stood just away from it. In the course of the development of the beach ridges all these islands became connected with one another and with the mainland, whilst the enclosed parts of the sea rapidly developed into swamps. The sequence of this process can be read from Fig. 2. The inland beach ridges do not exceed a height of twenty-five feet, and the most recent beach ridges do not reach more than ten feet above present mean sea level.

A beach ridge formed when the sea level was twenty feet higher than at present could now be expected — if other conditions remained unchanged — to lie at heights of thirty feet or less above present mean sea level. The younger beach ridges, formed as the sea level fell, would be correspondingly lower. The present situation is fully in keeping with this contention. It appears therefore that the differences in height between the inland and the coastal beach ridges can be fully ascribed to eustatic factors. Coastal terraces, which might correspond with stationary stages in the fall of the sea level, are reported from several islands further offshore (13). It would seem that several terrace levels can be distinguished, mainly between five and fourteen feet above mean sea level.

It will be evident from the description and explanation given above that no tectonic land movements are involved. First of all there is no evidence for them, and secondly there is no need to assume them. Nevertheless, many authors state that in post-Pleistocene times the Malayan land mass, and particularly the eastern half of it, rose in an absolute sense (3, 5, 14, 15, 16). Fitch described 'raised beaches' in the Kuantan area at two levels, namely at thirty-six and fifteen feet above sea level; he postulates an uplift of the land in two phases, one of twenty and the other of ten feet, and finds additional proof in caves and wave-cut notches. In north-eastern Johore, however, there are no signs at all of a tectonic uplift of the land, there are only signs of a eustatic fall of sea level. The coastal terraces on the offshore islands could also be ascribed to eustatic, rather than to tectonic, movements (13). There is seemingly little justification for the application of the term 'raised beaches' to the beach ridges in the area of study.

CONCLUSIONS

In the Old Land, especially in the Quartzite-Shale Series, two distinct zones of weathering can be recognized, one below the other. The contact of weathering on the fresh rocks lies far below the surfacial zone of mass movement. The sculpture of the Old Land is characterized by rather uniform, slightly convex,

land slopes, by important mass movement and by a fine drainage texture. The combination of these factors produces a uniformity of down-wearing which may be different in rate for areas with totally different rock types, but which ignores structural differences within one major unit.

The present-day coastal geomorphology shows the result of a combination of accretion and cliff recession, thus producing a marked straightening and shortening of the coast-line.

There is no evidence for recent tectonic uplift. Eustatic lowering of the sea level is held to be responsible for the decreasing altitude of the inland beach ridges in a seaward direction. This fall in sea level may have been a major factor in accelerating coastal accretion. During the period in which the sea level was about twenty feet higher than at present, which may probably correspond to Daly's sub-recent higher sea level, estuaries penetrated far inland and the eastern part of the Old Land showed a number of islands. These were successively attached to the mainland as the sea level fell.

REFERENCES

1. Dale, W. L., 'The Rainfall of Malaya, Part I', *Journal of Tropical Geography,* Vol. 13, 1959, pp. 23-38.
2. *Geological Map of Malaya, 1948,* Survey Department, Federation of Malaya No. 35—1948.
3. Scrivenor, J. B., *The Geology of Malaya* (London, 1931).
4. Agocs, W. B., in collaboration with J. R. Paton and J. B. Alexander, 'Airborne Magnetometer and Scintillation Counter Survey over parts of Johore and Malacca', *Economic Bulletin 1.5,* Geological Survey, Federation of Malaya.
5. Fitch, F. H., 'The Geology and Mineral Resources of the Neighbourhood of Kuantan, Pahang', *Memoir No. 6 (New Series),* Geological Survey, Federation of Malaya, 1952.
6. Bakker, J. P., 'Quelques aspects du problème des sediments corrélatifs en climat tropical humide', *Zeitschrift für Geomorphologie,* Neue Folge, Bd. I, 1957, pp. 1-43.
7. Büdel, J., 'Die doppelten Einebnungsflachen in den feuchten Tropen', *Zeitschrift für Geomorphologie,* Neue Folge, Bd. I, 1957, pp. 201-28.
8. Savigear, R. A. G., 'Technique and terminology in investigation of slope forms', *Premier Rapport de la Commission pour l'Etude des Versants,* Rio de Janeiro/Amsterdam 1956, pp. 66-76.
9. Lobeck, A. K., *Geomorphology* (New York, 1939).
10. Nossin, J. J., 'Occurrence and Origin of Clay Pebbles in northeastern Johore, Malaya', *Journal of Sedimentary Petrology,* in press.
11. Richardson, J. A., 'An Outline of the Geomorphological Evolution of British Malaya', *Geological Magazine,* Vol. 84, 1947, pp. 129-44.
12. Daly, R. A., *The Changing World of the Ice Age* (New Haven, 1934).
13. Burton, C. K., in a personal communication.
14. Bemmelen, R. W. van, *The Geology of Indonesia,* Vol. I-A (The Hague, 1949).
15. Scrivenor, J. B., 'Geological and Geographical Evidence for Changes in Sea Level during ancient Malayan History and late Pre-history', *Journal of the Malayan Branch of the Royal Asiatic Society,* Vol. 12, Part 1, 1949, pp. 107-15.
16. Fitch, F. H., 'Evidence of Recent Emergence of the Land in East Pahang', *Journal of the Malayan Branch of the Royal Asiatic Society,* Vol. 12, Part 1, 1949, pp. 115-22.

RECENT DEVELOPMENTS IN MEXICAN SULPHUR PRODUCTION

By FRANK SEAWALL

THE UNITED States is no longer the only major source of Frasch process sulphur now that Mexican sulphur deposits are being mined. Considerable evidence appears to indicate that Mexico will become increasingly important in the near future as a sulphur producer. Mexico's first Frasch process sulphur was produced in the Isthmus of Tehuantepec in 1954; since then development and production have been increasing rapidly (Fig. 1). Current annual production, which is over one million tons per year, has placed Mexico second only to the United States in world production of native sulphur.

The existence of sulphur in the Isthmus of Tehuantepec has been known since 1915 when evidence of sulphur deposits was revealed by core samples obtained when drilling for petroleum. Several papers were published describing the salt domes and sulphur formation. However, since no petroleum was discovered, the drilling rigs were transferred to new locations. It was not until 1944, when the three Brady brothers, veteran Latin American oil wildcatters, became interested in the possibility of sulphur as a result of having heard of some of the old logs which revealed sulphur formations. Concessions were then obtained and additional drilling revealed several significant deposits of sulphur-bearing limestones.

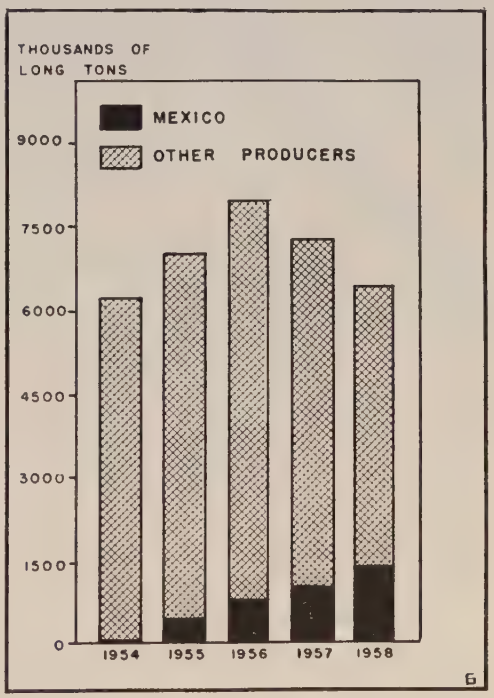


Fig. 1. World production of native sulphur (Bureau of Mines).

A review of the world's supply and demand for sulphur during the last twenty-five years reveals either over-production or short supply. The relatively large stockpile of sulphur accumulated during the nineteen-thirties was reduced considerably during the Second World War. The Korean War caused an even greater depletion in supply so that it was during this period that the first price controls were placed on sulphur since the demand exceeded the supply. The black market price rose from U.S.$21.00, the controlled price, to U.S.$200.00 a ton. These were the conditions when Mexican sulphur deposits were first developed.

GEOLOGY

The geology of the Isthmus of Tehuantepec is almost identical with the sulphur-producing area in Louisiana and Texas. The sulphur-bearing limestones

are anticlines which hold hot water with a minimum of seepage; hence, the Frasch process can be used for recovery. It is assumed that in the past this Isthmus was a saline basin and the geological structures have been formed due to flowage of the salt. It is thought that the varied structures in this immediate area are subordinate to a regional uplift of the salt mass, resulting in a piercement type of dome or anticline. Surface sediments are of Middle and Lower Tertiary Age and consist of dark grey shale with occasional lenses of grey sands and volcanic ash. Dip slopes measure up to 15 degrees. The exact age of the salt is unknown but fossils of the Cretaceous Age have been found in several instances in formations which are stratigraphically higher than the salt domes (1a).

RESERVES

In an evaluation of mineral reserves for future production, several major problems are encountered. Reserve data are at times misleading due to the difficulty of classification of mineral deposits into the various categories of reserves: proven, probable, and implied, or into a synonymous classification of workable, indicated, or inferred reserves. A problem also exists in the changing classification of a mineral deposit from one reserve category to another due to technological changes in processing which often make it possible to utilize lower grade deposits. Price changes of the mineral may also cause a mineral deposit to change its reserve classification, since due to price increases it may become economically feasible to mine and process lower grade minerals. The opposite is likely to occur with a price reduction.

Although it is relatively difficult to determine the exact size of the sulphur reserves, it has been established by test drilling that the deposits of the Isthmus of Tehuantepec are sufficient to be classified as one of the major sulphur deposits in the world, probably second only to the Gulf Coast deposits in the United States. Two of the three sulphur producers in the Isthmus of Tehuantepec, after exploration and test drilling in only about five per cent of their total concession areas, report total proven reserves of sulphur of slightly over 33,000,000 long tons(2). Reserve datum is not always available, as in the case of a third sulphur producing company operating in Mexico which did not require additional financing to develop their Mexican concessions. Some mineral producers take the view that mineral reserves data are confidential information. When a mining company wishes to increase capitalization by the sale of stocks or bonds, it is usually necessary to disclose mineral reserves data in order to sell the securities.

Probable and implied sulphur reserves data will not be stated since this type of mineral survey is often in great error, and the proven reserves of the Isthmus appear sufficient to justify an optimistic outlook for the future of the Mexican sulphur industry. The errors in estimating the size of a mineral deposit can be illustrated by conflicting statements made concerning the San Cristobal dome in the Isthmus: '... still has no idea of the extent of sulphur in the San Cristobal dome except it is believed to be the largest in the world'(3); 'Estimated reserves of the San Cristobal dome are 2,830,000 tons'(1b); 'The San Cristobal dome was closed due to depletion of reserves'(4); 'Total sulphur production from the San Cristobal dome was approximately 152,000 tons'(5a).

PRODUCTION BY THE FRASCH PROCESS

Mexican sulphur production has had a spectacular increase which is typical of a new mineral producing area. The first year of production by the Frasch process

was in 1954 when 52,000 tons were produced; by 1958 production reached 1,236,000 tons or approximately 19 per cent of the world's total production of native sulphur (Fig. 1). During the Korean War the demand for sulphur exceeded supply which served as an incentive to increase production; at that time Mexican sulphur first entered the world market and since then the supply has exceeded the demand. Due to the high initial cost of production, there is a normal tendency to begin production as soon as possible to help the producer recover a return on the investment.

The Frasch process, developed by Herman Frasch just before the turn of the last century, is being used to recover the sulphur from the Mexican domes. The first phase of the process is drilling, with a rig similar to the type used in oil exploration, into the sulphur-bearing formations. Three concentric pipes are then inserted into the drilled hole to tap the deposit. Since the sulphur deposits are overlaid by a non-porous cap rock, superheated water at a temperature of 330°F. is pumped down the outside pipe into the porous sulphur bearing limestones under light pressure. Sulphur, which melts at 240°F., rises part way up the middle pipe and then is brought to the surface by an air lift. Compressed air is forced down the innermost pipe at fairly high pressures which serves as the air lift for the hot liquified sulphur.

FACTORS FAVOURABLE TO PRODUCTION

In addition to the favourable geological structure for the Frasch process, and the relatively large proven reserves, there are several other factors which are advantageous to sulphur production on the Isthmus of Tehuantepec. Sulphur produced in this area has relatively easy access to the major sulphur markets. The site of the sulphur deposits is such that it is a short rail or barge haul to the deep water port of Coatzacoalcos (Fig. 2). This port, which provides protection from the open waters of the Gulf of Mexico, can accommodate ocean vessels with a draft up to 28 feet. Sulphur shipments to the Pacific can be made via the Panama Canal or by rail across the Isthmus to the Pacific port of Salina Cruz which is less than 150 miles from the sulphur deposits. At present this latter route is not used, but should be considered as a possibility for future shipments. Easy access to the Mexican markets is provided by rail facilities which connect with railroads serving all of Mexico.

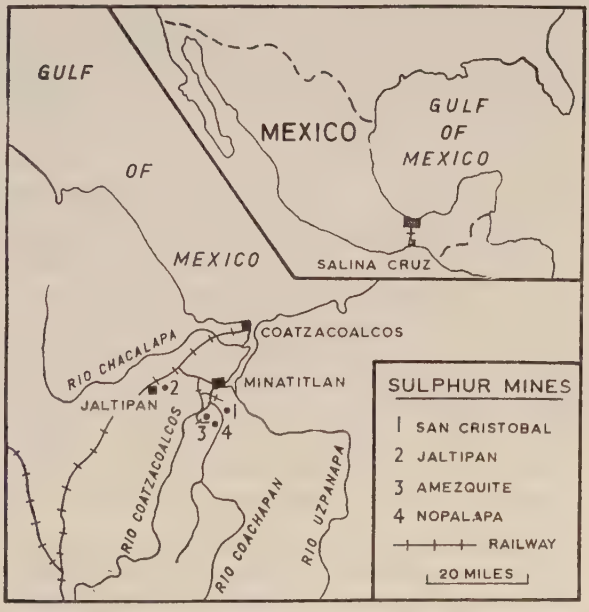


Fig. 2. The sulphur producing area on the Isthmus of Tehuantepec.

Transportation costs of Mexican sulphur to markets on the east coast of the United States are usually lower than for sulphur produced in Texas and Louisiana. An

important advantage favouring Mexican sulphur producers is that they may ship sulphur in vessels whose rates are substantially less than vessels registered in the United States (6). Commodities produced in the United States must be shipped in United States registered vessels when transporting to domestic ports.

The local labour supply of the Isthmus has proved adequate to meet the demands of the sulphur producers. Some of the local labourers were trained in working with drilling rigs and pipes as a result of former experience obtained in the nearby oil fields.

The Chacalapa and the Coachapan Rivers provide ample fresh water for use in the Frasch process. Although there is some seasonality to precipitation in the drainage basins, these rivers have sufficient water to meet the demands of sulphur producers even during periods of low water. After the soft water has been stored in reservoirs, it is prepared for the boilers by additional softening by a soda ash and lime process.

Fuel oil, used to heat the water for the Frasch process, is available locally from Mexico's third largest petroleum refinery at Minatitlan. Petroleum has been produced on the Gulf Coast of the Isthmus for many years. Fuel costs should be reduced considerably when natural gas, from a newly developed field in Tabasco, 150 miles east of the sulphur deposits, becomes available. An absorption plant for natural gas was completed in 1958 and the pipeline was scheduled for completion in 1960. In Texas and Louisiana natural gas has proved to be a most efficient fuel for the Frasch process method of mining sulphur. Transport and storage charges for fuel should be reduced with the conversion from oil to natural gas (5b). At present oil is shipped by barge or tank car to the storage tanks near the plants.

Sulphur gases resulting from the Frasch process can create problems in areas of concentrated population. Since the Mexican sulphur formations are located a sufficient distance from inhabited centres it is not necessary to neutralize the escaping sulphur gases.

PROBLEMS IN PRODUCTION

Several problems have been encountered in sulphur production on the Isthmus. One of them is the presence of impurities in the Frasch process sulphur. Since most markets require sulphur with lesser amounts of organic material than normally mined, this necessitates a filtration of the raw sulphur. Oil comprises the bulk of the organic materials. One producer reported its raw Frasch sulphur as having the following composition: 99.48 per cent sulphur; 0.42 per cent organic material and 0.10 per cent ash. After filtration, which adds approximately U.S.$5.00 per ton to the cost, the composition is: 99.64 per cent sulphur; 0.22 per cent organic material and 0.14 per cent ash (7). The maximum usable organic content of sulphur for the chemical industry is normally 0.30 per cent.

The typical bright yellow colour which is usually associated with sulphur is not characteristic of Mexican sulphur. Strong prejudices developed against Mexican sulphur, when it was first marketed in 1954 and 1955, due to its yellowish-brown colour. The chemical industry soon realized that the colour of the sulphur was immaterial as far as use was concerned, since its chemical composition was satisfactory. However, manufacturers of paper have found that the colour of

Mexican sulphur does affect the finished paper. The classic yellow colour can be obtained from the Mexican sulphur by additional processing which adds to costs.

Sulphur production equipment requires greater care in Mexico than in the producing area of the United States. A maintenance problem is created by the hot moist climate of the Isthmus which causes materials to deteriorate more rapidly.

Another problem is the possibility of serious damage to sulphur production and shipping facilities by diastrophism. On 26 August 1959, an earthquake with a magnitude of 7.25 on the Richter scale practically destroyed the town of Jaltipan (Fig. 2). The damage to sulphur company facilities resulting from this earthquake was relatively insignificant and there was no apparent damage to the sulphur domes or their overlying structure. However, production from one company was temporarily reduced so that company employees could render assistance to the inhabitants of Jaltipan. The trans-isthmus railroad, used for sulphur shipments, was slightly damaged, but the track was restored to working order in three days and there was no loss of export shipments caused by the railroad being inoperative. Although there is no prior evidence of recent diastrophism in the Isthmus, there is now the possibility of more serious damage to the sulphur production facilities.

As a result of increased economic nationalism, demands have been made for Mexican ownership of the sulphur facilities. At present virtually all the sulphur properties and production equipment are owned by United States nationals. Several demands appealing for support of nationalization have appeared in the Mexican press. However, the present Government, business, and financial groups have expressed the view that the present legislation regulating foreign investments is satisfactory (8).

Although both the United States and Mexican sulphur producers are subject to various taxes levied by the local and federal governments, the Mexican producers are at a competitive disadvantage with respect to certain taxes. The Mexican Government collects substantial royalties from sulphur producers. One of the producers has been paying a 20 per cent royalty since September 1959. Mexico has no depletion allowance for sulphur, whereas the United States has a 23 per cent depletion allowance for sulphur producers (9). However, it should be stated that Mexican sulphur producers have received some special tax considerations from the Mexican Government which have encouraged sulphur development.

STORAGE AND LOADING

The liquid filtered sulphur is cooled and solidified in large outdoor storage vats. The sulphur is pumped through pipes into large open top moulds where great care is taken to add only a few inches of sulphur per day to the top of each vat. If too much sulphur is added to one section of the mould, pockets of liquid develop within the solidified sulphur.

The movement and loading of the solid sulphur from the storage vats, located adjacent to the docks, into the vessels is a relatively simple process. The sulphur, which is first crushed, is transported by conveyor directly into the holds of vessels. These conveyors are equipped with a telescopic chute which directs the flow of the sulphur into various sections of the hold. This type of loading permits trimming the holds, thus saving time and labour. Loading time varies

with the equipment in use and the whims of the vessel's commanding officer. One of the sulphur docks is equipped with facilities for loading vessels at the rate of 2,000 long tons per hour (10). The officers of some vessels demand that all holds be loaded at a comparatively uniform rate; this requires additional moving of the loading equipment which increases loading time. Minimum loading time is obtained when each hold is loaded and trimmed separately.

THE FUTURE

In attempting to forecast the future for the Mexican sulphur industry, one must first view the prospective demand for the mineral and then evaluate the role of the Mexican sulphur producers. As our urban-industrial society continues to increase its demand for basic minerals and with the continued expansion of the chemical industry, it is logical to assume that the future demand for sulphur will continue to increase since it is an essential industrial raw material. As there are no substitutes for sulphur, a steady and substantial market may be expected (11). The Materials Policy Commission's report, *Resources for Freedom,* estimated that the United States sulphur consumption by 1975 would be 10,115,000 long tons. This would be an increase of 82 per cent over apparent consumption in 1957 (12). It is likely that sulphur consumption in other nations may increase at an accelerated rate resulting from their greater percentage increase in consumption of chemicals. With the world's expanding population the demand for sulphate fertilizers to increase agricultural productivity appears to be one of the logical steps towards a partial solution of the food problem.

The future for the Frasch process sulphur production may not be as bright as for the entire sulphur industry. Currently, sulphur is being recovered as a by-product from the conversion of sour natural gas into sweetened natural gas. The plains flanking the eastern slopes of the Rocky Mountains from Northern Canada to New Mexico, and the northern slopes of the Pyrenees Mountains have huge reservoirs of sour natural gas. Facilities for the production of sulphur as a by-product from these gas reserves are currently operative in Canada, France and the United States. In 1958, this source supplied approximately 10 per cent of the world's sulphur (13).

It is somewhat difficult to compare production costs of Frasch produced sulphur with the by-product since the latter depends largely on the demand for natural gas. However, one source states that recovered sulphur is less expensive to produce than Frasch produced brimstone (14). Another source states that production costs of the Frasch process and the hydrogen sulphide recovery processes are not believed to be seriously out of line (5c). Operating costs and obsolescence seem to favour the Frasch installations. Drilling costs both for development and production are less in a sour gas operation. American experience indicates that overall costs of the two processes are at least reasonably comparable.

Nearly 45 per cent of the world's sulphur requirements are currently obtained from the roasting of pyrites which show an average sulphur content of about 40 per cent. Several nations, including the United States, have substantial reserves of this mineral and some nations may depend on pyrites for their future sulphur needs. The roasting of pyrites has several disadvantages compared with the Frasch process. Physically, over twice as much material must be handled when obtaining sulphur from pyrites. The roasting process also creates a dust nuisance and there is the problem of the disposal of the cinders. As a result the production of sulphur from pyrites can be expected to decline in the future, unless it is maintained by tariffs or other artificial barriers.

Sulphur and sulphuric acid are also obtained as a by-product from the smelting of some copper, lead, and zinc sulphide ores and from the refining of certain crude oils. These sources should also be considered in an evaluation of future sources of sulphur. However, the potential of these sources seems limited compared with the Frasch process and sour gas.

The prospects for the Mexican sulphur deposits appear promising, provided that sulphur produced by the Frasch process continues to be the major source for this mineral. A survey of only about five per cent of the total sulphur concession areas has revealed proven reserves of over 33,000,000 long tons. The Isthmus of Tehuantepec provides the Mexican sulphur producers with ready access to ocean transportation. This site has a distinct advantage since sulphur is a low-priced, bulky commodity that cannot stand high transport costs. Sulphur produced from sour gas in Canada and the United States is not competitive with Frasch process sulphur from the Gulf of Mexico for the major markets because of transportation costs.

A new trend is developing in the form in which sulphur is being marketed. As most consumers have to remelt the sulphur before using it, there are distinct advantages in receiving the sulphur in molten form. Labour costs for handling liquid sulphur are normally less than for sulphur in the solid state. Finally, the molten sulphur eliminates wind loss from bulk storage and contamination from foreign substances.

The shipment of increased amounts of sulphur in the molten form should not materially change the markets for Mexican sulphur. Railroad tank cars and river barges transporting liquid sulphur from Texas and Louisiana will be able to serve the markets in the interior of the United States more effectively, but they currently enjoy this advantage. Other major markets, including the Atlantic Seaboard and Europe, can be supplied with ship loads of molten sulphur as effectively from Mexico as from Texas and Louisiana.

The continued development of the sulphur industry in Mexico can be expected to serve as a stimulant to Mexican industry in general. This project has provided Mexico with a basic industrial raw material which has assisted in the development of the nation's industry as well as supplying an important commodity for international trade.

REFERENCES

1. Kearney, John H., 'A New Empire of French Sulphur is Rising from the Jungles of Mexico', *Engineering and Mining Journal,* Vol. 156, 1955, (a) p. 77; (b) p. 73.
2. *Moody's Industrial Manual, 1959* (New York, 1960), pp. 1470, 1929.
3. 'In Latin America, Mexico', *Engineering and Mining Journal,* Vol. 155, 1954, p. 195.
4. *Chemical and Engineering News,* Vol. 35, 27 May 1957, p. 11.
5. Haynes, Williams, *Brimstone, The Stone that Burns* (Princeton, Van Norstrand Co., 1959), (a) p. 273; (b) p. 204; (c) p. 233.
6. Texas Gulf Sulphur Company, *Annual Report,* 1957, p. 7.
7. Unpublished report of the Gulf Sulphur Company.
8. 'Foreign Owners Stir Mexican Row', *New York Times,* 13 September 1957, p. 28.
9. 'Sulphur Shares — Inflation Hedges?', *Financial World,* 5 November 1958, p. 13.
10. Information disclosed to the author in an interview with Mr. Frank J. J. Mulder, Manager of filtration plant and loading dock of the Gulf Sulphur Company, Coatzacoalcos, Ver. Mexico.
11. Bowles, Oliver, *Seventy-five Years of Progress in the Non-metallics, 1871-1946* (American Institute of Mining and Metallurgical Engineers, New York, 1948) p. 333.
12. Based on apparent consumption of sulphur in the United States from *Minerals Yearbook, 1957.*
13. Texas Gulf Sulphur Company, *Annual Report,* 1958, p. 7.
14. Tanner, James C., 'Sulphur's Splurge', *The Wall Street Journal,* 28 May 1959, p. 19.

THE RUBBER INDUSTRY OF THE FEDERATION OF MALAYA

By OOI JIN-BEE

THE HISTORY of rubber in Malaya had its beginnings in the latter part of the nineteenth century (1, 2, 3a, 4a, 5). The rubber that is exported from Malaya comes from the latex of the tree *Hevea brasiliensis* — native of the Amazon Valley. In 1876 Sir Henry Wickham collected some 70,000 *Hevea* seeds from the Tapajos region of the Amazon and sent them to Kew Gardens in England. Malaya received its first consignment of seedlings from Kew in the same year, but these soon died. Another consignment was received in 1877, and the plants were successfully raised in the Botanic Gardens of Singapore.

Until the end of the nineteenth century *Hevea* was planted only on an experimental basis, and in conjunction with similar experiments using other rubber-yielding plants such as *Ficus elastica* and the Malayan species of *Willughbeia,* to determine which of the several varieties was best suited to plantation agriculture (6). But, by about 1895 the superiority of *Hevea* was established beyond doubt when it was found that it was easier to grow, and that it yielded a greater quantity and a better quality of latex than the other varieties. The year 1895 coincided with the advent of the first pneumatic automobile tyres. The rapid development of the motor car industry greatly increased the demand for rubber, causing prices to rise to levels which made rubber cultivation a highly profitable venture.

The first commercial attempt at rubber planting in Malaya was made by a Chinese who established an estate in the north-eastern section of Malacca in 1898. His example was soon followed by other planters, mainly European, who started a number of small estates in several localities in western Malaya. From this tentative beginning rubber soon became firmly established as the major revenue crop of the country. The successful introduction of *Hevea* into the agricultural economy marked the end of the search for a tropical crop that could be profitably grown in the Malay Peninsula.

The earliest plantation crops grown on a commercial basis were spices and gambier, which were cultivated on Singapore Island, Penang and the adjoining mainland (7). Of these, pepper was the most important, but its place in the economy declined until, by the middle of the nineteenth century, it became only a minor export crop (8). There was a similar decline in the export of cloves and nutmegs from Penang when plant diseases devastated large areas under these crops (9). Meanwhile the eighteen-thirties saw the introduction of another revenue crop, namely sugar, in Penang and Province Wellesley. Sugar-cane cultivation was given an impetus in 1846 when the British import duty on sugar was reduced. There was an immediate and rapid expansion of sugar estates, to such an extent that planters in Province Wellesley began to encroach on land in the Krian area of Perak. By 1899 there were about forty sugar estates in Perak, occupying a total area of more than 50,000 acres and employing between 8,000 and 9,000 labourers. But sugar did not last very long as a major revenue crop in Malaya. It has never been a very profitable industry, and severe competition from sugar-beet soon reduced prices to levels which forced the sugar-growers of

Malaya to cease production. The industry, however, lingered on until 1913 when the last refinery closed down (10, 11).

The last major revenue crop to be grown in Malaya before the introduction of rubber was coffee. *Coffea arabica* was planted on a small scale in many parts of the Peninsula, but it was not until the eighteen-seventies that it became a plantation crop, cultivated chiefly in Perak. In 1879 a fungus disease, which had decimated the coffee plantations of Ceylon, attacked the Malayan holdings and destroyed all hopes of establishing Arabian coffee as a major crop. A different species, *Coffea liberica,* was then tried in the hope that it would not succumb to the fungus. Planting on a fairly wide scale took place in the eighteen-eighties in Perak, Selangor and Negri Sembilan, and the Malays began to cultivate it as a peasant crop. At the end of 1896 there were seventy-two European-owned coffee estates in Selangor alone, occupying a total area of some 47,000 acres and with a labour force of about 4,000 Indians and Javanese. After an initial period of success the price became unremunerative as Brazilian coffee beans flooded world markets, and by 1901 all the European-owned estates of Liberian coffee had been inter-planted with the new crop — rubber. Although prices improved after 1912, coffee never regained its status as a major export crop (12, 13).

The failure of coffee coincided with the discovery that *Hevea braziliensis* would grow readily in Malaya. Between 1896 and 1899, as the price of coffee fell and pests and disease took their toll of the coffee trees, some of the growers began inter-planting *Hevea* with coffee. Rubber planting was pursued most vigorously in the area between Klang and Kuala Lumpur, where a number of coffee estates supplied land suitable for rapid planting. Later, as more seeds became available, areas of jungle were cleared and planted with rubber. The average price of rubber, between 1890 and 1900, was from Malayan $1.30 to $1.70 per lb. The decline of coffee and the high prices for rubber acted in conjunction to stimulate rubber cultivation on an ever increasing scale. The rubber areas increased from a meagre 345 acres in 1897 to about 50,000 acres in 1905. Coffee and sugar were then being grown mainly as catch crops inter-planted with young rubber trees. In the same year the export of rubber from the Federated Malay States was 105 tons, an insignificant figure compared with the 62,000 tons of wild rubber from South America and other tropical areas. But a large percentage of the Malayan rubber acreage was composed of trees which had not yet attained the tapping age of six to seven years. After 1905, as more trees reached maturity, there was a corresponding increase in rubber output from the Malayan plantations.

Planting was further stimulated when the demand for rubber forced prices to rise above $2.50 per lb. in 1906 and 1909, and to a record of nearly $5.50 per lb. in 1910. Boom prices prevailed from 1910 to 1912. The rubber acreage in Malaya leaped from 50,000 acres in 1905 to over 290,000 in 1909. The spectacular profits realized by the rubber estates during the boom of 1910 to 1912 encouraged investors to put their capital into the large number of new rubber companies being formed in London. Although prices dropped steadily from the record of $5.50 per lb. in 1910 to an average of 80 cents per lb. in 1920, the rubber acreage and production continued to expand. In 1919 the net exports of rubber from Malaya reached nearly 200,000 tons, exactly half the total world exports of rubber. The pioneers in rubber cultivation were Europeans and Chinese, but from 1910 onwards there was a rush by Malay smallholders to grow rubber. In some cases they cut down their fruit trees and even planted their padi fields with rubber; in others, especially where immigrant Malays were concerned, they cleared and opened up new land. Planting was greatly facilitated by the ease with which land could be obtained (14, 15, 16).

The first set-back to the industry came in the years 1920 to 1922 when prices dropped to depression levels, averaging 33 cents in 1921 and 1922. The slump was due to over-production aggravated by the post-war depression and by extravagant methods of cultivation. The Stevenson Committee of Inquiry was appointed in 1921 to study the situation. The final report of the Committee recommended that the production and export of rubber in Ceylon and Malaya be restricted and controlled by Government. The decision to impose restriction was made on the strength of the fact that Malaya and Ceylon together produced more than 70 per cent of the world's rubber, and in spite of the refusal of the Netherlands East Indies to co-operate in the Scheme. The object of the Stevenson Scheme was to raise prices above slump level, and to stabilize them at about 54 cents per lb. by curtailing production and imposing a system of variable export quotas. The Scheme was adopted in 1922 and restriction remained in force for six years until November 1928.

The immediate effect of restriction was to raise average prices to 54 cents per lb. in 1923, and 47 cents in 1924. The recovery of the motor car industry in the United States, and the growing demand for rubber, boosted average rubber prices to $1.25 per lb. in 1925. The price increases which resulted from restriction in Malaya and Ceylon benefitted all the other rubber producing countries in the world, especially the Netherlands East Indies. Because they were not partners in the Stevenson Scheme, the Netherlands East Indies were able to take advantage of the rise in rubber prices by increasing production and planting new areas with rubber. The result was that, while the share of Malaya and Ceylon in total world exports of rubber fell from 70 per cent in 1922 to 52 per cent in 1927, the Netherlands East Indies' share over the same period rose from 25 per cent to more than 40 per cent. The total planted area of rubber in the Netherlands East Indies increased from 378,000 hectares in 1922 to 526,000 hectares in 1928. At the same time, restriction in Malaya and Ceylon encouraged the use of reclaimed rubber in the United States, so that the demand for natural rubber dropped and the accumulated stocks of rubber on the market could not be cleared.

The effect of increased production in the Netherlands East Indies and the drop in demand in the United States was to lower the price of rubber to 85 cents per lb. in 1926. In spite of the Stevenson Scheme, the price of rubber continued to fall steadily until it reached about 36 cents per lb. in 1928 and 1929. By then it was apparent that the Scheme was no longer effective because of Dutch competition, and it was therefore abandoned in 1928. During the six years of the Scheme the Government of Malaya had followed a policy of refusing to alienate land for new planting, with the result that Malaya lost its place to the Netherlands East Indies as the territory with the world's largest planted area of rubber. By 1929 the total planted area in the Netherlands East Indies was 3,155,000 acres, and that in Malaya was 2,945,000 acres, but a much larger percentage of the acreage in the Netherlands East Indies consisted of immature rubber so that its production remained less than that of Malaya.

With the end of restriction, rubber production increased greatly and surplus stocks began to accumulate as more and more rubber than could be consumed came into the market. In 1930 the market for rubber collapsed due to the world depression, and prices slumped to the lowest so far recorded. Average world prices during the Great Depression were 19 cents per lb. in 1930, 10 cents in 1931, 7 cents in 1932, 10 cents in 1933 and 22 cents in 1934. The effects of the Depression in Malaya were serious. A very large percentage of the rubber smallholders discontinued tapping and turned to growing food crops. Some of the estates also stopped production and there was wide-spread unemployment as the estate labourers

were discharged. The other estates managed to survive the crisis by practising the strictest economies, and greatly reducing their costs of production to the levels where they could avoid loss at the current prices.

It became clear to all the rubber producers, including the Dutch in the Netherlands East Indies, that some form of restriction had to be imposed on production if the industry was to survive. Accordingly, a committee was appointed for the purpose of formulating a plan to regulate production from the rubber-growing countries of South-east Asia, India and Ceylon. The new agreement was signed by all the countries concerned and came into effect in May, 1934. From then until the outbreak of the Second World War rubber production in South-east Asia, India and Ceylon was controlled by the International Rubber Regulation Committee. A definite quota was assigned to each producing country for each year. The basic quota for Malaya in 1935 was fixed at 504,000 tons. At the same time the Malayan Government stopped the alienation of land for rubber planting and prohibited new planting, although it permitted replanting of old rubber land. This law was relaxed for 1939 and 1940 when producers were permitted to engage in new planting on an area equivalent to 5 per cent of their 1938 acreage.

With the curtailment of exports the price of rubber began to improve. The average price increased gradually from about 21 cents per lb. in 1934-35 to about 43 cents in 1941, the improvement being due as much to the armaments race and stockpiling as to export restrictions.

The 1920-22 depression, the Great Depression and the restriction schemes of 1922-28 and 1934-41 put a check to rubber planting in Malaya (3b, 4b, 17, 18, 19, 20). In fact the official policy over this period was to discourage new planting by refusing to alienate land for rubber. In spite of this, the rubber acreage increased from 2,945,000 acres in 1929 to 3,481,000 acres in 1940, of which 2,107,000 acres were in estates and 1,374,000 acres in smallholdings, that is holdings of less than 100 acres. The increase in planted area was due to new planting on land already alienated but not yet planted with rubber. Such land had been held either in reserve and unplanted, or for the cultivation of other crops. Many of the larger estates had reserved land which could be used for the purpose, but most smallholders did not have unplanted reserve land. The only alternative was to grow the rubber on land which was under other peasant crops, such as coconuts, fruit and even padi. That many of them were willing to do this and sacrifice a source of income indicates the great attraction rubber growing had for the smallholders. Some of them ignored the planting ban during the Stevenson Scheme and grew rubber on land which had been alienated for other crops, while others went even further and established holdings on untitled land.

The rubber industry, in common with the other industries of Malaya, suffered a reversal during the Japanese occupation. Planting and production came to a standstill. The occupation period saw the destruction of about 8 per cent of the estate acreage and about 4 per cent of the smallholding acreage of the country. In addition, there was wide-spread destruction of factories and other buildings as well as machinery. Many of the rubber areas suffered badly from general neglect and were unkempt and overgrown with lalang and other growth. The estate labour force was scattered: some of the labourers turned to food growing, others to wage earning in the towns, whilst a large number of them were sent by the Japanese to help build the Burma-Siam railway. When the war ended only about one third of the pre-war labour force remained, so that the estates were greatly handicapped in their efforts to resume production (3c, 21).

The smallholders, on the other hand, relied mainly on family labour, and this, coupled with the fact that only the simplest equipment was required in their manufacturing processes, enabled them as a group to recover more quickly from the neglect of the war years. They were thus able to produce nearly 57 per cent of the total Malayan rubber for 1946, although owning only 44 per cent of the total acreage. By 1947, however, estate efficiency had been restored and estate production exceeded that of the smallholders for the first time after the war. Since then the estates have produced between 55 and 60 per cent of the Malayan rubber output (Fig. 1).

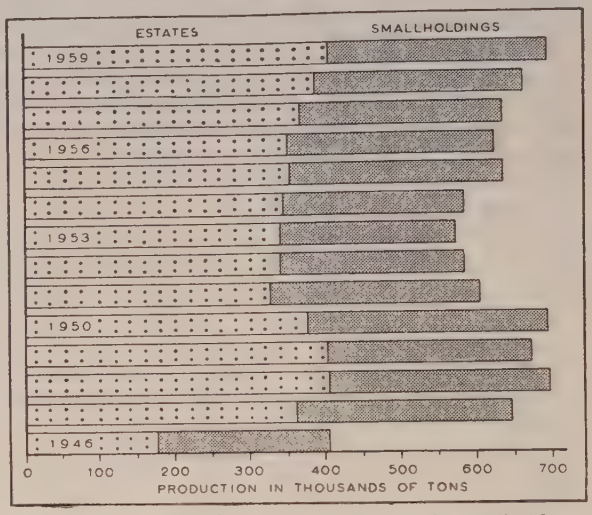


Fig. 1. Rubber production by estates and smallholdings in Malaya, 1946-59.

The Malayan rubber industry suffered another set-back when the Communist uprising broke out in 1948. One of the major aims of the communists was to disrupt the national economy by armed attacks on the rubber estates and the intimidation of workers. Whilst they did not succeed in attaining their objective, the attacks, nevertheless, seriously hampered production in some of the more remote estates. In addition, the estate sector of the industry had to bear part of the heavy expenditure involved in providing protection for the plantations. This financial burden cut deeply into the profits for 1948 and 1949, when the profit margin for estates was already poor because of low average prices — 42 cents per lb. in 1948 and 38 cents in 1949. However, the overall production remained high.

When the Korean War broke out prices soared high as the United States began to build up her stockpile of rubber. Prices rose to $1.08 in 1950 and later to a post-war record of $1.69 per lb. However, the boom petered out quickly and by 1953 average prices had fallen to 67 cents per lb., and since then they have remained below $1 per lb., except in 1955 when prices reached $1.14, and again in 1959 when the average price was $1.01.

The total area under rubber in Malaya has not increased to any great extent since 1941. From 1946 to 1957 the total area increased by about 112,000 acres, mainly due to new planting by estates rather than by smallholders. The planted area in 1957 was approximately 3,520,000 acres, of which slightly more than 2,020,000 acres were in estates and about 1,500,000 acres in smallholdings. The total acreage has since fallen to about 3,450,000 in 1959, due mainly to a decrease in the estate area (22).

Indonesia has the world's largest planted area under rubber, estimated at roughly 4,500,000 acres. Production in that country, however, is only slightly more than in Malaya, and has been hampered in recent years by internal political and economic troubles. The other rubber growing countries are Thailand, Ceylon, Sarawak, West Africa and South America. Malayan rubber is exported to most of the industrial countries of the world, but the United Kingdom is the largest

single importer, followed by the United States. These two countries together regularly consume about 40 per cent of the total Malayan output, although consumption fell to less than 30 per cent in 1958 and 1959. The U.S.S.R. and Japan have become important customers of Malayan rubber in recent years.

METHODS OF CULTIVATION AND PRODUCTION

The rubber tree, *Hevea brasiliensis,* is a hardy plant and in its native habitat in the Amazon Valley can survive the fiercest competition from the other jungle species. It is a large tree with a straight trunk and high branching limbs. The smooth dark green oval leaves are shed once a year between January and April, but all the trees are never devoid of leaves at the same time. During this 'wintering' period there is a temporary drop in yield. The tree grows best in an equatorial climate with constantly high temperatures and a heavy, evenly distributed rainfall of 80 to 100 inches or more per year (23, 24). As far as climatic conditions are concerned, the rubber tree will thrive in any part of the Malay Peninsula below an elevation of about 1,000 feet; its growth becomes stunted at elevations above 1,500 feet (25).

It is also undemanding in its soil requirements but grows best in soils which are friable, deep, well-oxidised and acid in reaction (pH 4.0 to 6.5). Rubber covers 64 per cent of the total agricultural area of Malaya and is planted on a wide variety of soils. The value of the alluvial soils, most of which contain large amounts of impervious clay, depends upon adequate drainage. They are suitable for rubber if the water table lies at an average depth of more than forty-two inches. The soils derived from acid igneous rocks (granite) support good stands of rubber, but the sides of most of the granitic mountain ranges are too steep for agriculture. However, rubber is planted where such soils occur in the foothills. Soils derived from basic igneous rocks (Pahang Volcanic Series and Kuantan Series) are the most fertile of the inland residual soils, and rubber trees grow to a large size and give high yields when planted in them. Sedimentary rocks cover a large proportion of the foothills and undulating land between the coastal plains and mountain ranges of western Malaya. Soils derived from such parent materials are of variable value

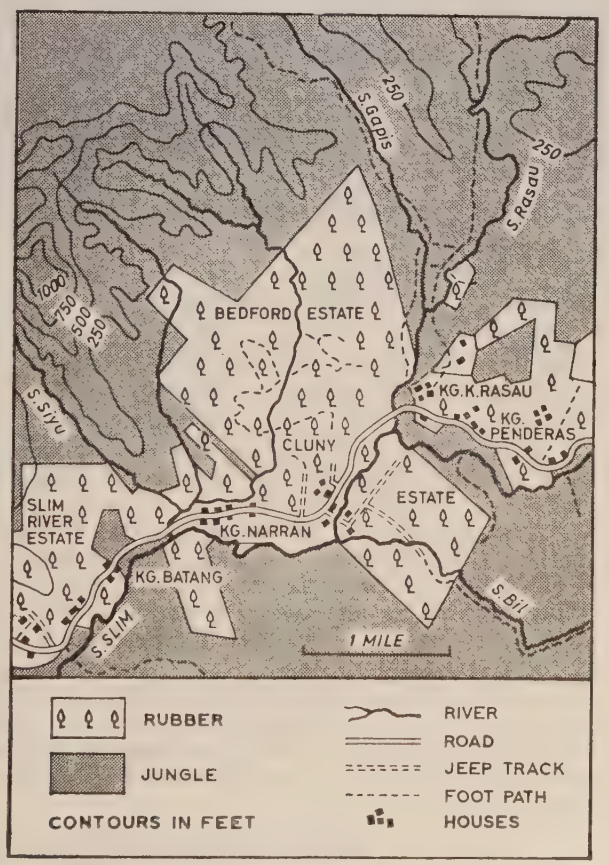


Fig. 2. Rubber estates established on well-drained foothill locations (Batang Padang District, Perak) (60).

for rubber cultivation. Soils derived from sandstones can be cultivated with *Hevea,* but those developed from shales and phyllites usually contain a lateritic hardpan which is highly resistant to root penetration. Rubber trees planted in areas where the hardpan lies near the surface become stunted and give very poor yields (26, 27).

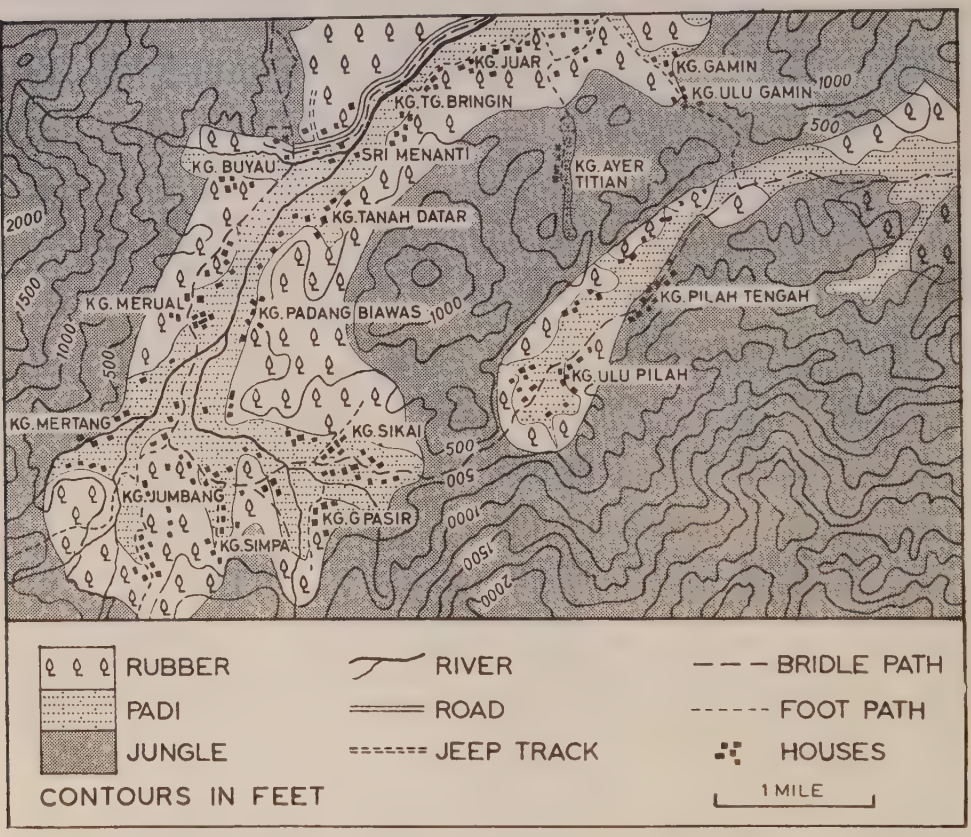


Fig. 3. Peasant landscape in a hill and valley location, with padi on valley bottoms and rubber on valley sides (Kuala Pilah District, Negri Sembilan) (60).

Hevea will not grow well in areas of impeded drainage. Good drainage is necessary to maintain a sufficient concentration of oxygen in the soil atmosphere, to allow excess carbon dioxide to diffuse away from the root zone, and to assist in the removal of toxic hydrogen sulphide from the soil. The best sites are undulating land with good natural drainage (Figs. 2 and 3), but flat swampy areas can be converted into good rubber land by an efficient drainage system. Much of the swampy land along the west coast of Malaya has been rendered suitable for rubber cultivation by careful drainage (Fig. 4). However, rubber trees planted on recently drained peat soils may have their roots exposed through progressive subsidence of the land as the peat dries, and are liable to fall over in a strong wind (25, 28, 29, 30).

Most of the rubber holdings have been established on land formerly under jungle, though some of the oldest estates are on land previously under other crops, such as sugar, gambier, coffee or tapioca. Some of the Malay smallholdings, too,

are planted on land formerly under subsistence crops, such as padi, coconuts or fruit.

The processes involved in establishing a rubber holding have remained substantially the same since the early days of rubber cultivation in Malaya. The selected site is cleared of its jungle cover and the felled timber left to dry for two or three months. The timber is then set on fire. The requirements for a successful burn are (i) a period of three consecutive days without rain immediately prior to the day of the burn, (ii) several hours of sunshine on the day of the burn to dry off the dew and (iii) at least a slight breeze to help spread the fire. Burning, however, causes a great loss of organic matter and nitrogen from the soil, although it is the cheapest and most efficient way of clearing the jungle. Soil exposure may be reduced by clearing the site of its vegetative cover without burning. But the advantage of conserving the humic matter is more than offset by the difficulty of movement of labour, the problem of controlling root disease and weeds, and the dangers of pest damage which result from this method.

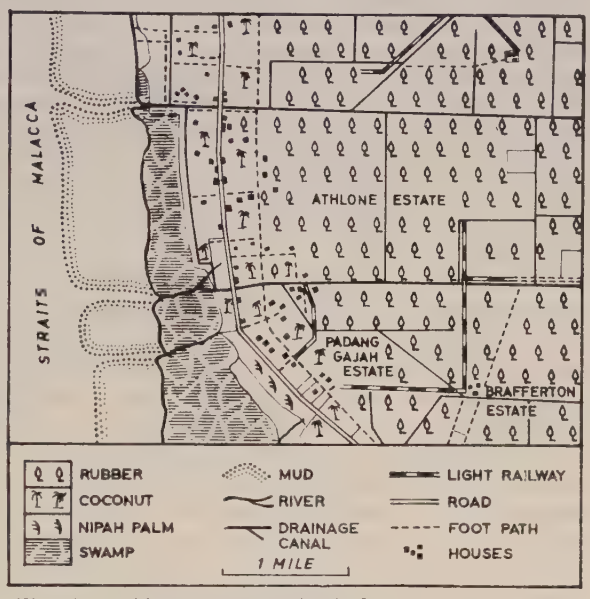


Fig. 4. Rubber estates established on a coastal swampy location (Kuala Selangor — Klang Districts, Selangor) (60).

In the early phase of rubber cultivation in Malaya the land was clean-cleared after burning and the rubber seedlings planted on the bare land (31). In recent years, however, it has been recognized that cover crops are necessary to protect the soil from excessive exposure and erosion. Apart from affording such protection, cover crops help to aerate and drain the soil, they preserve its structure and enrich it with mineral nutrients taken up from below, or, in the case of leguminous covers, through the fixation of atmospheric nitrogen by bacterial action. There are two types of cover crop employed in estates: (i) leguminous creepers such as *Centrosema pubescens* or *Pueraria javanica* and (ii) indigenous plants, except such undesirable weeds as lalang (*Imperata cylindrica*), bracken, stagmoss and Straits rhododendron (32, 33, 34). However, no cover crops are planted in many of the Chinese and Malay smallholdings. Instead, the spaces between the rubber trees are inter-planted with revenue crops, such as gambier, tapioca, pineapples and bananas. They are usually grown for two or three years until the rubber trees branch out and form too dense a shade for further successful cultivation. Apart from cover crops, other methods of soil conservation may be necessary. On steep slopes terracing may be required as well as cover crops, and on moderately steep slopes contour bunding with a cover crop planted on the bunds is common. The cover crops are put in as early as possible after clearing, and having established themselves the planting of rubber begins. Another method of soil conservation on slopes is to dig silt-pits. The soil from the pits is placed on the upper edge to check the force of the water running down the slope.

In the first few decades of rubber cultivation in Malaya most of the estates, and practically all the smallholdings, were planted with unselected seedlings. The unselected seeds were either raised initially in nurseries, or in baskets, and then transplanted to the field when they reached a height of about eighteen inches. Some were planted directly in the field. Two or three seeds were planted per hole and the weaker seedlings removed after six to nine months, leaving only the most vigorous seedling. But the trees raised from such seed gave highly variable yields. The modern practice is to plant only selected material which has been proved to be capable of high yields. A number of such high-yielding varieties or clones[1] have been developed by the Rubber Research Institute of Malaya, and by similar organizations in the other rubber-growing areas of the world (notably Indonesia). There are two ways in which high-yielding material may be propagated — through clonal seedlings or through budded stumps. By the first method the seeds from clones which have been proved to be high yielders are planted and the seedlings used to stock the holding. In the second, a high-yielding clone is grafted onto an ordinary seedling (called the root-stock) to produce a budded stump. This is done in a nursery and the budded stumps are then transplanted into the field (35a).

The policy in the large European estates is to maintain a limited number of trees per acre. The pre-war practice was to plant an initial stand of 120 to 180 trees per acre, and subsequently to thin them out until a final stand of 80 to 100 trees per acre was obtained (19a). The optimum density for high-yielding trees is about 120 per acre, with initial stands of 180 trees per acre for a budded stand, and 200 per acre for clonal seedlings. However, there is no hard and fast rule about the most profitable planting density (36). In contrast to estate practice, planting on smallholdings is very dense. Initial stands on smallholdings are between 300 and 500 trees per acre, with final stands of between 200 and 400 per acre (37). The aim of the smallholders is to obtain a high yield per acre through dense planting, while the estates aim at high yields per tree.

The smallholder does not normally apply any manure or fertilizer to the growing plants. The general practice in estates, however, is to add fertilizers to most soils at different stages in the growth of the trees. Fertilizers are thoroughly mixed with the top six to eight inches of soil in the planting hole at the time of transplanting the seedling or budded stump from the nursery, rock phosphate or an organic manure being used. Experimental work at the Rubber Research Institute has indicated that a mixture of phosphate, potash and nitrogen should be given at regular intervals during the growth of the young rubber plants in order to ensure against deficiencies of these elements. With some soils, however, one or more of these mineral elements can safely be omitted without impairing the growth of the trees. Sulphate of ammonia or mixtures containing nitrogen and phosphate are most commonly used in mature rubber holdings. Potash is added to the mixtures in areas with very sandy soils. Rubber planted on alluvial clay and soils derived from the Pahang Volcanic Series of rocks require little or no manuring (38, 39, 40).

It takes from five to seven years, from planting, for a rubber tree to attain its tapping age. Tapping is the controlled wounding of the bark of the rubber tree so that the latex vessels are opened and the liquid latex flows out. Latex itself

1. A clone is a group of plants, all the individuals of which are obtained by vegetative propagation from a single parent tree, whether directly or by multiplication.

consists of about 60 per cent water, 35 per cent rubber hydrocarbon, and the remainder small percentages of mineral constituents. One of the main steps to the successful establishment of rubber cultivation in tropical Asia was the discovery of the proper method of tapping, a discovery made by H. N. Ridley and other pioneers at the turn of the nineteenth century. The modern method of tapping is to cut a thin shaving of bark (bark excision) from the trunk at regular intervals, the cut being made at an angle so that the latex flows down into a cup placed to receive it. The cut is made by a special tapping knife. The tree is tapped once daily, or once in two, three or four days by reopening the cut with the tapping knife. There are many different tapping systems practised in Malaya, depending upon the type of tree (whether grown from unselected seedlings, clonal seedlings or budded stumps), the method of cultivation (whether estate or smallholding), the prevailing rubber prices, and on individual preference. The ideal system is one which gives the highest yields at lowest tapping costs, with the best growth and bark renewal, and the lowest incidence of brown bast (a disease of the tapping panel). The main systems used are those in which (i) the cut extends around half the circumference of the tree and the tree is tapped on alternate days; (ii) the cut extends as a spiral around the full circumference and the tree is tapped once in four days; (iii) the cut extends around a third of the circumference and the tree is tapped on alternate days; and (iv) the trees are tapped continuously for six to twelve months and then rested for two to six months (41, 42, 43).

The yield of latex varies considerably with the type of planted material. Table 1 gives the average yields for estates in Malaya as a whole. The difference in yield between unselected seedlings and high-yielding material is considerable. An acre of high-yielding rubber can produce more than twice as much latex as an acre of rubber grown from unselected seedlings. Experimental trials conducted by the Rubber Research Institute have shown that yields of 1,500 to 2,100 lb. per acre per annum can be obtained from the best of the high-yielding material (35b, 44, 45, 46). However, some rubber growers, mainly peasant farmers, continue to plant ordinary unselected seedlings in their new holdings in spite of the obvious advantage of high-yielding material. For example, 49 per cent of the 92,000 acres of rubber planted in 1957 were of unselected seed. Ignorance of the advantages

TABLE 1: YIELD PER ACRE FOR HIGH YIELDING MATERIAL AND UNSELECTED SEEDLINGS, 1955-59

YEAR	HIGH YIELDING MATERIAL Yield in lb. per acre per annum	UNSELECTED SEEDLINGS Yield in lb. per acre per annum
1955	806	355
1956	781	354
1957	806	374
1958	854	404
1959	898	434

to be gained from cultivating high-yielding rubber, or of the existence of such rubber, accounts for the peasant farmer's failure to take advantage of the research work of plant breeders. The national as well as the peasant economies are adversely affected through the planting of unselected seedlings, because valuable rubber land is unnecessarily locked up for a considerable period of time under low-yielding

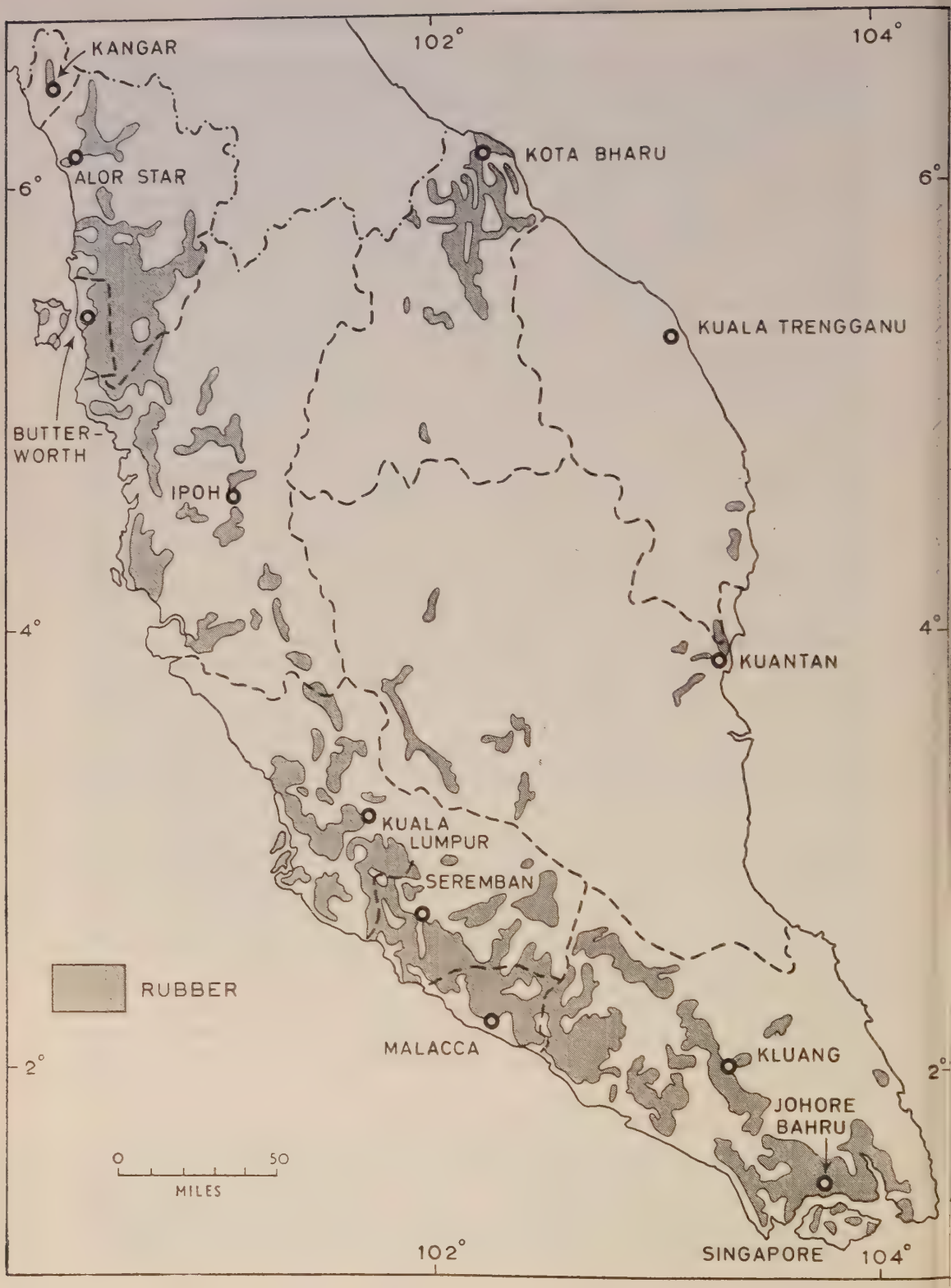


Fig. 5. Distribution of rubber, 1960.

rubber, when the same piece of land could be put to much more productive use if planted with selected high-yielding material.

In preparing latex for export it is first coagulated by the addition of a small quantity of formic or acetic acid. The smallholder will then pass the resultant coagulum through rollers and dry the final sheet in the sun or by smoking. An estate will treat the coagulum in one of several different ways. It may be passed through rollers and the rolled sheet dried in a smoking shed, or, it may be passed through a creping machine and air-dried for ten to fifteen days in a drying shed. The final product in the first case is ribbed smoked sheet, and in the second crepe rubber. Also, some estates prepare concentrated latex for export. This is done by removing some of the unwanted water in ordinary latex by a centrifugal process, or by creaming, or by evaporation, and preserving the concentrated latex through the addition of ammonia. The advantages of concentrated latex lie in a considerable financial saving in connection with preparation and transport, as well as in freight and packing. The export of concentrated latex from Malaya has increased from 40,000 tons in 1948 to 129,000 in 1959. Of the 783,000 tons of rubber exported from Malaya in 1959, 59 per cent was in the form of ribbed smoked sheets, 24 per cent crepe rubber, 16 per cent concentrated latex, and 1 per cent was exported in the form of skim rubber.

THE DISTRIBUTION AND TYPES OF RUBBER HOLDINGS

The Malayan rubber industry is divided and stratified according to size, and nationality of ownership. The situation in regard to the estates is summarized in Table 2. The larger estates (2,000 acres and above) are controlled mainly by Europeans (including Americans), whilst Asians are predominant as owners of the smaller estates. In general, Europeans own the largest estates, Chinese the medium-sized and Indians the smallest. Malays own less than 2 per cent of the total estate acreage.

TABLE 2: NATIONALITY OF OWNERSHIP OF RUBBER ESTATES IN MALAYA, 1959

SIZE GROUPS (acres)	EUROPEAN		ASIAN		TOTAL ACREAGE
	Number of Estates	Acreage	Number of Estates	Acreage	
Under 500	44	11,604	1,451	280,862	292,466
500– 999	78	59,284	211	153,152	212,436
1,000–1,999	183	264,593	108	145,241	409,834
2,000–2,999	84	211,561	21	48,947	260,508
3,000–4,999	83	320,647	12	43,267	363,914
Over 4,999	47	330,328	10	80,143	410,471
TOTAL	519	1,198,017	1,813	751,612	1,949,629*

* includes 7,725 acres planted in Singapore.

The distribution of rubber estates is shown in Table 3. Ninety-one per cent of the estates are concentrated in western Malaya from Kedah in the north to Johore in the south (Fig. 5). This zone or belt, sometimes referred to as the Tin and Rubber Belt, varies in width from five to forty miles, and covers the coastal

TABLE 3: DISTRIBUTION OF RUBBER ESTATES IN MALAYA, 1959

STATE	NUMBER OF ESTATES	TOTAL ACREAGE
Johore	512	540,663
Selangor	338	330,989
Perak	398	270,059
Negri Sembilan	286	269,212
Kedah & Perlis	277	213,163
Malacca	149	116,829
Pahang	189	114,052
Kelantan	58	40,985
Penang & Province Wellesley	60	28,514
Trengganu	39	17,438
TOTAL*	2,306	1,941,904

* Does not include the 26 estates covering 7,725 acres in Singapore.

plain, inland freshwater swamps and the foothills up to an altitude of about 500 feet. The earliest rubber holdings were developed on the drier sites of the undulating lowlands and the slopes of the foothills. But the great demand for rubber land soon led to the reclamation of extensive areas of swamp land.

There is a lack of accurate statistics with regard to the smallholding sector of the Malayan rubber industry. A smallholding is defined as 'an area, contiguous or non-contiguous, aggregating less than 100 acres, planted with rubber or on which the planting of rubber is permitted, and under a single legal ownership' (22a). The available statistics indicate that, of the estimated 1,500,000 acres of smallholdings roughly 50 per cent are Malay-owned, 30 to 40 per cent Chinese-owned, and the remainder are owned by Indians and others. About 15 per cent of the total smallholding acreage is in the eastern States of Kelantan, Trengganu and Pahang; the remainder is distributed along the Tin and Rubber Belt of western Malaya. Within the smallholding category there are two types of holding differing from each other in size. The larger of these is the medium-holding which ranges from 25 to 100 acres, and the smaller is the peasant-holding which is less than 25 acres. About 80 per cent of the total smallholding area belongs to the peasant-holding type.

The marked concentration of rubber holdings along the western littoral of the Peninsula, as illustrated in Fig. 5, is the result of a fortuitous combination of circumstances. Given the demand for rubber and its products in world markets, the successful establishment of *Hevea* depended upon three other main factors, namely, (i) suitable conditions of climate and soil; (ii) a cheap and abundant labour supply and (iii) a cheap and efficient means of transport. The natural conditions of climate and soil were found to be well suited for the growth of *Hevea,* especially the well-drained gentle slopes of the foothills on both sides of the mountainous backbone of the Peninsula, and the undulating land of southern Malaya. Cheap and plentiful labour was available from South India. But the special attraction of western Malaya for the rubber planters was provided by the skeleton network of roads and railways already laid out to serve the tin mining industry of the western foothills. The combination of a good transport system, well-drained sites, and proximity to the deep-water ports of Penang and Port Swettenham as points of entry and exit for labour, materials and processed rubber,

probably accounts, more than anything else for the concentration of rubber cultivation in this part of the country. In addition, many of the earliest rubber estates were planted in the western States on land which had once been under sugar or coffee. Another factor which attracted the planters to this part of the country was the early establishment of political stability in the tin-rich States of Perak, Selangor and Negri Sembilan. The success attending the first ventures at rubber cultivation gave further impetus to agriculturists to open up more land for the crop. All these influences have worked to establish the greatest concentration of rubber in a broad belt running from Kedah in the north to the south-western extremity of the Peninsula.

The distinction between the two main types of rubber holdings, estates and peasant-holdings, does not lie in differences of size alone. The limits of an estate are usually well-defined. It generally presents a picture of orderliness, with the rubber trees growing in neat rows, and the undergrowth kept down by constant cutting. Some estates have little or no undergrowth and in this respect resemble the orchards of temperate lands in appearance. Each estate is served by an internal system of roads or laterite tracks radiating from a focal point (marked by the processing factory) to all parts of the holding, with pathways from tree to tree. There is also direct connection between the processing factory and the nearest main road or railway line. Occupying a focal position in the estate is a group of buildings composed of the manager's house, the processing factory and smokehouse, and the labourers' quarters. One of the main differences in the functioning of an estate as opposed to a peasant-holding is the source of labour. Labour is hired, either directly or by contract. There is also a division of labour within an estate — one group being engaged in tapping and latex collection, another in the preparation and processing of latex, a third in packing the finished rubber, and minor groups in weeding and general upkeep of the estate. Fifty per cent of the 282,500 labourers employed in estates in 1959 were Indians, 30 per cent Chinese and 20 per cent Malays. Fifty-three per cent of them were male, 42 per cent female and the remaining 5 per cent young persons.

The peasant-holding has a very different external appearance from that of the estate. The rubber trees in a peasant-holding are often inter-planted with fruit, coconut, or other trees and bushes. The rubber trees do not always form continuous stands but may be in isolated clumps separated by other vegetation. Beyond the environs of the peasant's house, the mixed stand of rubber and other tree crops usually gives way to a pure stand of rubber growing in the midst of tall undergrowth and rubber seedlings which have taken root from fallen seed. This pattern of mixed stands facing the road, river or railway and pure stands in the interior is wide-spread throughout Malaya. Peasant-holdings of this kind may stretch for many miles on both sides of a line of communication, with no clear boundaries between individual holdings. The processing shed is usually near the house and consists of nothing more than an open-sided thatched structure over a mangle or roller. There is no division of labour, the peasant and his family performing all the tasks of tapping, collecting, processing and drying the rolled sheets. The dried sheets are transported by bicycle and sold as low grade rubber to the nearest rubber dealer, who is usually also the local shopkeeper.

PROBLEMS FACING THE RUBBER INDUSTRY

It is difficult to over-emphasise the importance of rubber in the national economy. Malaya regularly produces between 600,000 and 700,000 tons of rubber each year, that is roughly one-third of the world production of natural rubber.

Rubber occupies 64 per cent of the total cultivated area of the country and contributes about 60 per cent of the total export earnings.

In the sixty years since *Hevea* was first introduced into the Peninsula, Malaya has emerged from economic obscurity to occupy the position of a leading supplier of rubber to the international commodity markets. The industry has attracted overseas capital and given impetus to the development of all the States. The attendant benefits of prosperity have in their turn permeated all spheres of life. Public services in the form of roads, railways and harbours, and social welfare amenities including health and education, have expanded accordingly to cover a large section of the population. The standard of living in Malaya is the highest in South-east Asia.

But the prosperity of the rubber industry was not achieved without a struggle. In the course of attaining its pre-eminent position in the country, the industry had to overcome a number of problems which at times threatened to overwhelm it. These problems were not connected with the actual growing of *Hevea,* for in Malaya there is no disease that threatens the rubber plant in the way that the South American leaf blight devastates rubber holdings in Tropical America (47). One of the most serious obstacles to rubber cultivation in the Peninsula was malaria. Most of the estates which were established in the early years of the industry were on the gentle slopes of the foothills in western Malaya. The main and most dangerous malaria vector of the Peninsula — *Anopheles maculatus* — has its natural habitat in the clear, sunlit waters of small running streams. This vector was responsible for very high death-rates among rubber estate workers. The clearing of the forest and its undergrowth for rubber created favourable conditions for the multiplication of *maculatus.* The result was an extremely high malarial infection among the susceptible labour force recruited from South India. In 1911, for example, 9,000 out of a total estate labour force of 143,000 died from malaria. Individual estates suffered regular heavy losses from the disease. For instance, the Highlands and Lowlands Para Rubber Limited had a mortality rate of 20 per cent every year during its pioneering phase. Nearly half the labourers of the Midlands Estate died in the three years 1910 to 1912.

The problem of malaria was overcome through the efforts of Ross, Watson and Strickland, who evolved various methods of controlling the numbers of vectors by the destruction of their larvae. One very successful method was subsoil drainage, whereby all running water was led into underground drainage pipes out of the reach of the anophelines. Such a method, however, was too expensive for estate application. It was later discovered that a mixture of crude oil and kerosene when poured over the breeding locations completely destroyed the mosquito larvae, and this method was widely adopted by the estates. Oiling, together with the increasing use of drug prophylaxis, led to a spectacular fall in the incidence of malaria and by 1935 malaria had ceased to be a major problem both in the estates and in the towns (48a).

Rubber is especially liable to violent fluctuations in price. The rubber growers in Malaya have experienced periods when the price of rubber has fallen far below the cost of producing it, whilst at other times boom prices have prevailed. Figure 6 illustrates the range of average prices for the years 1926-59. Between the average of 7 cents per lb. for 1932 and 169 cents for 1951 is a difference of 2,400 per cent. Figure 6 shows the annual average prices only; the degree of fluctuation for monthly prices would be even wider. In seeking the advantages of crop specialization, rubber planters, as well as the country as a whole, have to face the liability of price instability. The problem is one over which the planters have little control,

for the price levels are determined by the interplay of international market forces, and are tied in with the general economic as well as political conditions of the world. In some tropical countries, such as those of West Africa, semi-governmental organizations called Produce Marketing Boards help to smooth out the ups and downs of commodity prices by guaranteeing prices for any one season and taking up all the produce that local growers can supply. The Marketing Boards then sell the produce at the prevailing world prices in the commodity markets, profiting or losing by the transaction as the case may be. There are no such marketing boards in Malaya, and all rubber growers, estates as well as smallholders, are fully exposed to price risks.

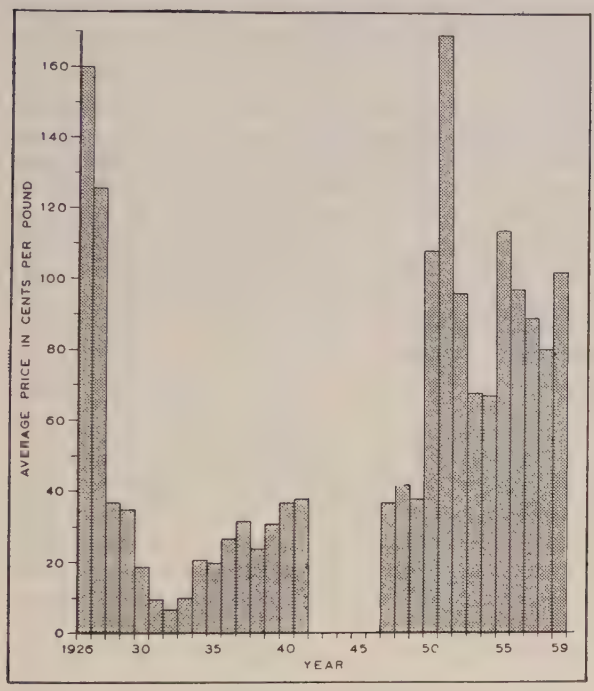


Fig. 6. Average annual price of rubber (No. 1 Ribbed Smoked Sheet) in Malaya.

The rubber planters of Malaya, as well as the natural rubber producers in other parts of the world, are now faced with serious competition from the synthetic product. Synthetic rubber production expanded considerably during the Second World War. The Japanese conquest of South-east Asia deprived the Allies of most of their natural rubber, and forced them to manufacture the synthetic product on a large scale in order to continue the war effort (49). The total production increased from a mere 2,560 tons in 1940 to 820,350 tons in 1945. In 1959 the total world output of synthetic rubber was 1,640,000 tons compared with the total output of 2,067,500 tons of natural rubber. Synthetic rubber is a serious threat to natural rubber producers, and production is expanding as new factories are set up in an increasing number of countries. New types of synthetic rubber are being made to meet the demands of special purposes. For example, Butyl rubber is less permeable than natural rubber and is therefore more suitable for pneumatic tyres. Moreover, whatever advantages the natural product might have had over synthetic rubber have now disappeared with the discovery of an exact synthetic duplicate of natural rubber (50). In 1955 the synthetic rubber factories of the United States were denationalized, and the private firms who purchased them have lowered their manufacturing costs to such an extent that the price of synthetics is now lower than that of natural rubber. For these reasons the general expectation is that for some years to come there will be a steady drop in the price of natural rubber (51a, 52, 53).

The Malayan rubber planters can only meet this competition by lowering their costs of production, improving the quality of natural rubber, and increasing output through the planting of high-yielding material. The wages of the tapping

force alone make up about 40 per cent of the costs of production on an estate planted with unselected seedlings (51b), and it is unlikely that there will be any general reduction in labour costs, because of the rising standards of living and resistance from the strong labour unions. The estate sector of the industry must, therefore, cut down on other expenses in order to lower production costs. As far as the smallholders are concerned, their costs of production are negligible, but the quality of rubber processed by them is usually low and commands correspondingly lower prices. The scope for improving smallholder rubber appears to be great, and experiments on centralised processing of smallholder rubber into good quality sheets are being carried out.

The best and most practical method by which Malayan natural rubber can be made competitive in price with synthetic rubber is by increasing the yield per acre. As noted earlier, the high-yielding material planted in Malayan estates gives from two to three times as much latex as the unselected seedlings. The best clones are capable of yielding from 1,500 to 2,100 lb. per acre per annum as compared with the 350 lb. average for unselected seedlings. The policy followed in all estates today is to plant only high-yielding clones in new holdings, but many smallholders, through ignorance, continue to cultivate unselected seedlings in their new holdings. Fifty-five per cent of the total estate area of 1,941,904 acres in 1959 were already planted with high-yielding materials.

The other important problem facing the rubber industry is the replacement of old uneconomic trees with high-yielding material. Replanting has become an urgent necessity because a high percentage of the rubber acreage in Malaya is composed of trees which are too old to produce economic yields. The productive life of a rubber tree is about thirty-five years. The tree is not tapped until it is six or seven years old. The yield from the seventh year onwards increases rapidly until a peak is reached between the fifteenth and seventeenth year, after which there is a steady decline until the tree ceases to produce any latex. For this reason a rubber holding must be replanted with new trees about once every thirty years in order to maintain continuous production. However, because of the Great Depression of the nineteen-thirties, the Second World War, and because of a lack of foresight, especially on the part of the smallholders, a position was reached in 1952 in which more than 50 per cent of the planted acreage, both estates and smallholdings, was composed of trees which were more than thirty-three years old. The backlog of replanting in 1952 was estimated to be 1,500,000 acres, and in order to counter the combined threat of over-aged trees and competition from synthetic rubber, the rate of replanting must be accelerated (51c, 54, 55).

In order to assist the rubber industry in its replanting programme a special tax was imposed on all rubber exported from Malaya, and funds thus acquired were used to subsidize the cost of replanting in both estates and smallholdings. The smallholders were in a far worse position than the estates as a greater percentage of their acreage consisted of over-aged trees (48b). The Government therefore set a target of 480,300 acres to be replanted by the smallholders between 1953 and 1959. The actual acreage replanted up to 1959 is shown in Table 4. Whilst the rate of replanting on smallholdings has increased markedly in recent years it is still well behind schedule. The estates, aided by the Replanting Scheme and reserve funds of their own put aside for the purpose, have been replanting at a much faster rate than the smallholders. The slow progress in the smallholdings is due to a number of factors. In the early years of the Scheme many smallholders were not aware of their eligibility for a replanting grant, while others were

TABLE 4: ACREAGE REPLANTED ON ESTATES AND SMALLHOLDINGS, 1953-59

YEAR	ESTATES	SMALLHOLDINGS	
		Target	Area actually replanted
1953	29,800	40,000	29,500
1954	39,100	50,300	22,600
1955	57,600	60,000	25,300
1956	78,400	70,000	46,500
1957	76,300	80,000	49,800
1958	64,800	90,000	59,700
1959	68,200	90,000	76,700
Total	414,200	480,300	310,100

hesitant about applying for assistance until they were fully satisfied that it did not involve governmental control of their holdings. But the main reason for the slow rate of replanting was the reluctance on the part of the peasants to cut down their old trees and thus lose their major source of income for the six or seven years before new trees could mature. This reluctance became greater as the price of rubber increased, since the income lost through cutting down the trees would be correspondingly greater (51d, 56, 57, 58, 59).

Table 4 shows that the area actually replanted on smallholdings fell short of the target by 170,200 acres. The gap between the area of land with over-aged trees and the area of newly planted land will therefore grow wider each year. Though the estates are in a better position, both estates and smallholdings will have to speed up their rate of replanting in order to counter the threat from synthetic rubber.

REFERENCES AND NOTES

1. Ridley, H. N., *Story of the Rubber Industry, with an Appendix by L. Lewton-Brain showing the Growth of the Rubber Industry in Malaya* (London, 1911).
2. Jenkins, R. O., 'Rubber: Introduction and Expansion with Special Reference to Malaya', *British Malaya,* Vol. 26, 1951, pp. 296-9.
3. Allen, G. C., and Donnithorne, A. G., *Western Enterprise in Indonesia and Malaya* (London, 1957); (a) Chap. 6; (b) pp. 120-7; (c) pp. 127-8.
4. Mills, L. A., *British Rule in Eastern Asia* (London, 1942); (a) pp. 183-214; (b) pp. 189-214.
5. Marks, O., 'The Pioneers of Para Rubber Planting in British Malaya', *British Malaya,* Vol. 2, 1927, pp. 281, 285 and 292.
6. Many plant species, besides *Hevea,* are rubber-bearing. See L. G. Polhamus, *Rubber Content of Miscellaneous Plants* (Washington, D. C., 1957).
7. Wheatley, P., 'Land-use in the Vicinity of Singapore in the Eighteen-Thirties', *The Malayan Journal of Tropical Geography,* Vol. 2, 1954, pp. 63-6.
8. Milsum, J. N., 'Pepper in Malaya', *Malayan Agricultural Journal,* Vol. 18, 1930, pp. 274-5.
9. Mason, F. R., 'The Clove and Nutmeg Industry in Penang and Province Wellesley', *Malayan Agricultural Journal,* Vol. 19, 1931, pp. 4-8.

10. Bunting, B., 'The Cultivation of Sugar-cane', *Agricultural Bulletin of the Federated Malay States,* Vol. 8, 1920, pp. 96-7.

11. Burkill, I. H., *A Dictionary of the Economic Products of the Malay Peninsula,* Vol. II, (London, 1935), pp. 1925-40.

12. Bunting, B. and Milsum, J. N., 'Cultivation of Coffee in Malaya', *Malayan Agricultural Journal,* Vol. 18, 1930, pp. 481-2.

13. Milsum, J. N., 'Liberian Coffee in Malaya', *Malayan Agricultural Journal,* Vol. 19, 1931, p. 521.

14. Winstedt, Sir Richard, *The Malays: a Cultural History* (London, 1950), p. 127.

15. The *Straits Times,* 25th February, 1956.

16. *Report of the Survey Departments of Malaya, 1935* (Kuala Lumpur, 1936), Pt. iv, Appx. 1, pp. 55-6.

17. MacFayden, Sir Andrew, *The History of Rubber Regulation, 1934-43* (London, 1944).

18. Lewis, H., *Rubber Regulations and the Malayan Plantation Industry* (Washington, 1935).

19. Bauer, P. T., *The Rubber Industry: a Study in Competition and Monopoly* (Cambridge, 1948); (a) pp. 56, 68.

20. Bauer, P. T., 'The Working of Rubber Regulation', *Economic Journal,* Vol. 56, 1946, pp. 391-414.

21. Mills, L. A., *Malaya: a Political and Economic Appraisal* (London, 1958), pp. 155-6.

22. Unless otherwise stated all statistics relating to rubber in the Federation of Malaya are from *Malaya, Rubber Statistics Handbook, 1959* (Kuala Lumpur, 1960); (a) p. 5.

23. Djikman, M. J., *Hevea* (Florida, 1951), pp. 243-6.

24. Wyllie, J. A. and Ferreira, O. G., *Notes on Rubber Cultivation* (Madras, 1907), pp. 18-22.

25. Grist, D. H., *An Outline of Malayan Agriculture* (London, 1950), pp. 77-8.

26. Owen, G., 'A Provisional Classification of Malayan Soils', *Journal of Soil Science,* Vol. 2, 1951, pp. 20-42.

27. Hamilton, R. A., 'Soil Investigations in Relation to the Cultivation of Rubber Trees in Malaya', reprinted from *The Planter,* Oct., 1936, pp. 1-7.

28. Edgar, A. T. (compiler), *Manual of Rubber Planting* (London, 1947), pp. 7-8.

29. Akers, R. L., 'Drainage of Low Coastal Areas', *Planters' Bulletin of the Rubber Research Institute of Malaya,* No. 27, 1956, pp. 101-104.

30. 'Drainage on Estates', *Planters' Bulletin of the Rubber Research Institute of Malaya,* No. 28, 1957, pp. 20-2.

31. Clean-weeding resulted in extensive loss of top-soil in Malayan rubber estates, a loss estimated to be equivalent to about 330 tons per acre per annum during the years when clean-weeding was common practice. See Sir Lewis Fermor, *Report upon the Mining Industry of Malaya* (Kuala Lumpur, 1939), pp. 153-4.

32. 'Cover Plants — a Discussion', *Planters' Bulletin of the Rubber Research Institute of Malaya,* No. 37, 1958, pp. 90-3.

33. Watson, G. A., 'Cover Plants in Rubber Cultivation', *Journal of the Rubber Research Institute of Malaya,* Vol. 15, 1957, pp. 2-18.

34. Haines, W. B., *The Uses and Control of Natural Undergrowth on Rubber Estates* (2nd ed., Kuala Lumpur, 1940).

35. For a discussion of the relative merits of buddings and seedlings, see 'Buddings and Clonal Seedlings', *Planters' Bulletin of the Rubber Research Institute of Malaya,* No. 36, 1958; (a) pp. 51-9; (b) pp. 51-4.

36. 'Achieving an Optimum Stand', *Planters' Bulletin of the Rubber Research Institute of Malaya,* No. 34, 1958, pp. 5-10.

37. Smith, H. F., 'A Sampling Survey of Tapping on Small Holdings (1939-40)', *Journal of the Rubber Research Institute of Malaya,* Vol. 12, 1947, p. 94.

38. Owen, G. *et. al.,* 'Manuring *Hevea:* Effects of Fertilizers on Growth and Yield of Mature Rubber Trees', *Journal of the Rubber Research Institute of Malaya,* Vol. 15, 1957, pp. 29-52.

39. Haines, W. B. and Guest, E., 'Recent Experiments on Manuring *Hevea* and their Bearing on Estate Practice', *The Empire Journal of Experimental Agriculture,* Vol. 4, 1936, pp. 300-24.

40. Westrop, A. R., *The Use of Fertilizers on Malayan Rubber Estates* (2nd ed., Kuala Lumpur, 1939).

41. 'Tapping: an Introduction', *Planters' Bulletin of the Rubber Research Institute of Malaya,* No. 9, 1953, pp. 113-9.

42. 'Tapping Systems', *Planters' Bulletin of the Rubber Research Institute of Malaya,* No. 11, 1954, pp. 32-7.

43. Sharp, C. C. T. and Guest, E., 'Tapping Systems', reprinted from *The Planter,* Jan., 1939, pp. 1-9.

44. Mann, C. E. T., 'Improvement in the Quality of Rubber Planting Material', *Transactions of the Institution of the Rubber Industry,* Vol. 15, 1940, pp. 251-70.

45. Cramer, P. J. S., 'High Yield Rubber Material', *The Planter,* Nov., 1950, pp. 1-4.

46. Baptist, E. D. C., 'Recent Progress in Malaya in the Breeding and Selection of Clones of *Hevea Brasiliensis*', *Report of the 13th International Horticultural Congress,* Vol. 2, (Kent, 1953), pp. 1100-21.

47. The tree is, however, susceptible to a great number of other less serious diseases in Malaya. See R. N. Hilton, *Maladies of Hevea in Malaya* (Kuala Lumpur, 1959).

48. Ooi Jin-bee, 'Rural Development in Tropical Areas, with Special Reference to Malaya', *Journal of Tropical Geography,* Vol. 12, 1959; (a) pp. 47-60; (b) pp. 152-5.

49. *Synthetic Rubber, Recommendations of the President transmitted to the Congress, January, 1950* (Washington, 1950), pp. 21-6.

50. 'From Synthetic to Synthetic Natural', *Planters' Bulletin of the Rubber Research Institute of Malaya,* No. 43, 1959, pp. 75-6.

51. Mudie, R. F. and others, *Report of the Mission of Enquiry into the Rubber Industry of Malaya* (Kuala Lumpur, 1954), (a) pp. 1-3; (b) pp. 8-10; (c) Chaps. 2, 4, 5 and 6; (d) pp. 25-7 and Appx. E.

52. Gamba, C., *Synthetic Rubber and Malaya* (2nd ed., Singapore, 1959).

53. McGavack, J., 'The Future of Natural Rubber', *Natural Rubber News,* Mar., 1959, pp. s-1 to s-6.

54. *Final Report of the Rubber Smallholdings Enquiry Committee* (Kuala Lumpur, 1952).

55. International Bank Mission, *The Economic Development of Malaya* (Baltimore, 1955), pp. 245-52.

56. The Rubber Industry (Replanting) Board, Scheme No. 2, *Report on Operations by the Chief Replanting Officer for the Year 1955* (Kuala Lumpur, 1956).

57. The *Straits Times,* 22nd April, 1955.

58. The *Straits Times,* 6th June, 1955.

59. The *Straits Echo,* 30th October, 1954.

60. Figures 2, 3 and 4 are based on One Inch Topographical Maps of Malaya, and are printed in this Journal with the special permission of The Surveyor General, Kuala Lumpur, Malaya.

SOME FACTORS IN THE DEVELOPMENT AND PLANNING OF LAND USE IN BRITISH BORNEO

By Y. L. LEE

INTRODUCTION

AT PRESENT there is no large scale land-use map for any part of British Borneo. For Sarawak and Brunei the only map available is the *Land Use Map of Sarawak and Brunei* on the scale of 1 :250,000, published by the Land and Survey Department of the Government of Sarawak in 1957. This map was compiled from aerial photographs, and it attempts to classify the principal vegetational types as indicators of soil conditions and the potential use of the land. The same data has been summarized on the scale of 1 :500,000, of which Fig. 1 is a simplified version. As yet, there are no official land-use maps for North Borneo. Figure 2 has been compiled by the author, largely from aerial photographs.

Figures 1 and 2 reveal the striking fact that forests (excluding secondary forests resulting from shifting cultivation) cover more than 75 per cent of each of the three territories of North Borneo, Brunei and Sarawak, and they indicate that extensive areas of these countries are uninhabited. Equally apparent is the small area under settled cultivation. In Sarawak and Brunei only 6 per cent of the land is under settled cultivation, most of which is in the form of strips adjacent to water bodies, or in small patches around the larger coastal settlements. In North Borneo, where 4 per cent of the country is cultivated, the pattern is similar; agricultural lands in the east and the interior High Plains occur in patches around the principal towns. Along the west coast there occurs the only area of large contiguous units of cultivation in British Borneo, a feature associated with the development of the railway from Jesselton to Beaufort and then through the Padas Gorge into the Central High Plains.

The land-use maps also reveal the extent to which forests have been occupied by shifting cultivation. As much as 15.7 per cent (North Borneo 12; Brunei 21 and Sarawak 18 per cent) of British Borneo is classified as being utilised for shifting cultivation.

THE BASIS FOR FUTURE PLANNING

Future planning for the development of British Borneo must, therefore, take into account three important factors: (i) its large area (79,000 square miles); (ii) its small population (1,200,000), and (iii) the extensive areas of forest and the small percentage of farmland. As the population expands it is inevitable that conflicts will arise between the advocates of agricultural extension and those for forest conservation or, more correctly, within the triangle of settled agriculture, shifting cultivation and forests. As development proceeds the proportions of the country under these three kinds of land use will change, undoubtedly in favour of settled cultivation. But in view of the almost insurmountable obstacles presented by the physical features of the terrain, progress in this direction will probably be slow. Also, it seems certain that, for a long time to come, settlement will be concentrated largely in or around the 4 to 5 per cent of the country already under settled agriculture.

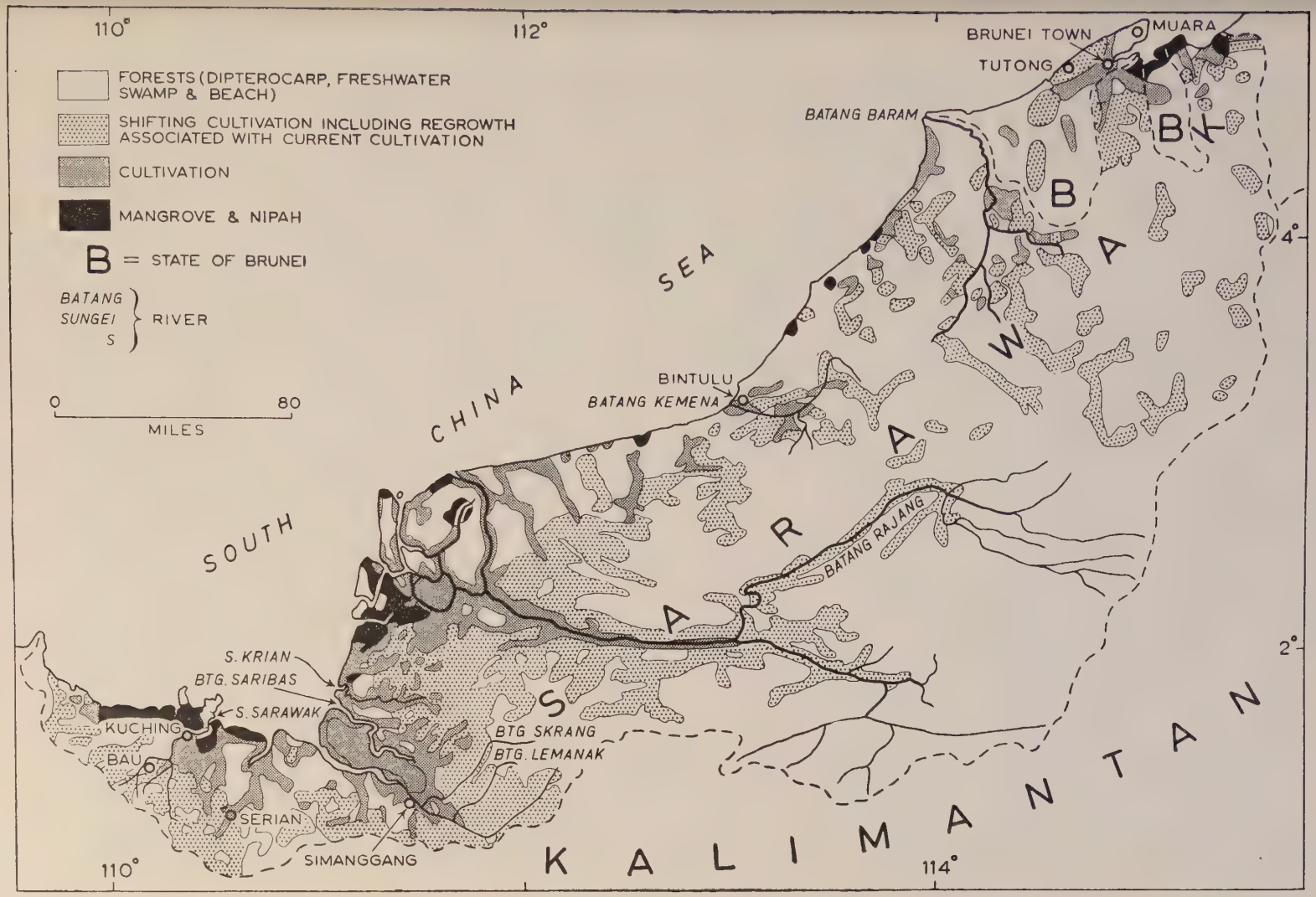


Fig. 1. Land use of Sarawak and Brunei.

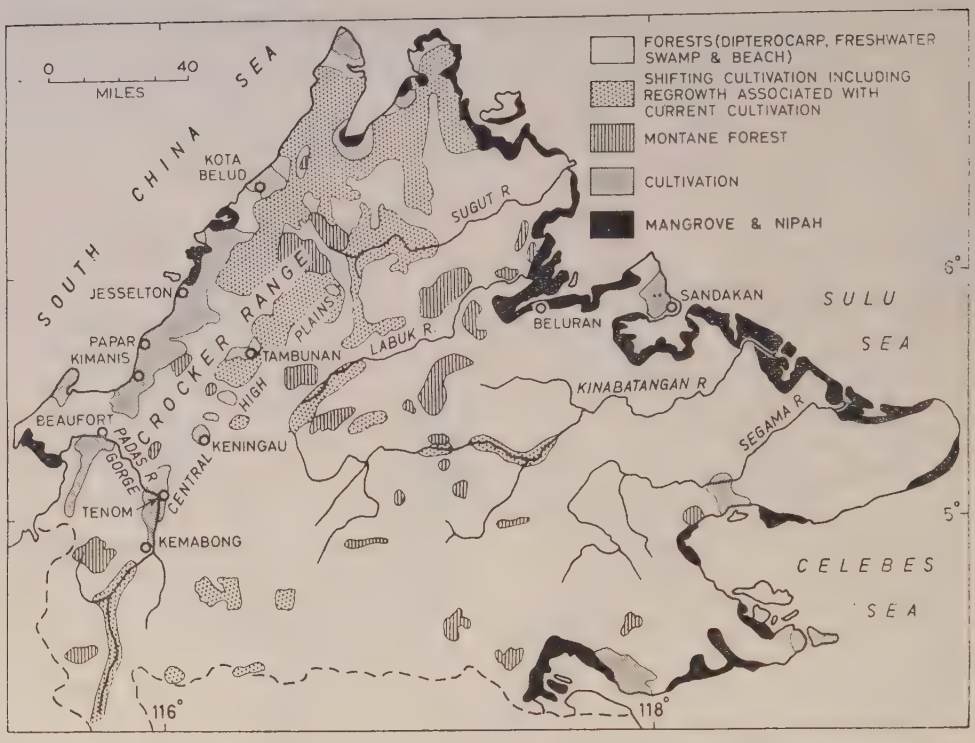


Fig. 2. Land use of North Borneo.

However, it would be unwise to assume that future settlement will necessarily occur only in association with the present cultivated areas. Being almost a virgin country and therefore without the restrictions imposed by a cultural landscape of long standing, such as often occurs in the more developed countries, the land use and settlement patterns of British Borneo are fairly free to develop as future events may decide.

Whilst the foregoing statement is basically true, attention must be drawn to certain changes now taking place in the community life of the people which will, to some extent, influence future patterns of both land use and land tenure. Perhaps land tenure is least susceptible to variation, since all land is held rigidly under one of three systems — (i) land alienated without respect of persons, for periods up to 99 years; (ii) title granted to indigenous people (1); and (iii) land belonging to the Crown. Land use, on the other hand, is much more liable to substantial modification by changes in community life.

CHANGES IN COMMUNITY LIFE AFFECTING LAND USE

One of the many changes now modifying the ways of life of the people arises from the suppression of inter-tribal warfare and attempts to eliminate some of the killer diseases. As a consequence, there has been, in some places, an increase in the size of the community, and a disturbance of the balance between population and the land. This, in turn, has occasioned changes in land use and tenure. The recent history of the Sea Dayaks of Sarawak illustrates this kind of change.

(i) *Trends in Sea Dayak migrations*

Prior to 1840 the Sea Dayaks were confined to the Simanggang area (2) (Fig. 1). Partly as a result of the gradual disappearance of strife between the tribes and the reduction of disease, the size of the Sea Dayak community increased. Under their system of shifting cultivation the soil was soon exhausted and fertile land became scarce. Large numbers of them therefore migrated northwards through Sarawak in search of new land. A short while before 1840 they began to move up the Batang Lemanak and the Batang Skrang, and northwards to the Saribas and Krian rivers. In the eighteen-forties they moved into the Rajang Valley of the Third Division, and during the second half of the nineteenth century they occupied extensive areas to the north of the Rajang River in the Third, Fourth and Fifth Divisions. The small tribes who had previously inhabited many of these areas were scattered and decimated as they were forced to retreat up-river.

The speed with which the Sea Dayaks moved is indicated by the fact that in 1870 there were no Sea Dayaks in the Bintulu District, but in 1940 there were 1,000 families and to-day they number more than 12,000. Before 1840 there were no Sea Dayaks north of the headwaters of the Krian, Skrang and Lemanak rivers, to-day there are more to the north (in the Third and Fourth Divisions) than in the south (in the Second Division), and some are found even in the northernmost Districts of Sarawak near the North Borneo border. This migratory process was accelerated by Brooke's punitive expeditions in the Saribas and Skrang areas (3). These mass movements resulted in changes in the land use of the whole of the Rajang area, from one of virgin forest to clearings for shifting cultivation. Tenure has also changed in that the Government, recognising the destructiveness of such cultivation, has re-classified these areas of shifting cultivation as 'interior areas' or 'native customary land', and has taken the precaution of establishing forest reserves in an attempt to restrict the movements of the shifting cultivators.

(ii) *Immigration*

A second factor tending to modify the way of life of the people and affecting land use is immigration. Improved communications in some parts have resulted in an influx of people from outside, and stronger contacts have been established between the indigenous communities and immigrant communities, particularly the Chinese, with different levels of social and economic development. The first large-scale immigration of the Chinese into the country took place in the eighteen-fifties with the movement of large numbers of gold miners and refugee farmers from Dutch Borneo. They moved into the Bau district and changed the forests into a landscape of mining settlements. The second large-scale immigration came later in the eighteen-fifties, sponsored by the tobacco companies and the Chartered Company in North Borneo. As a result of this influx, many parts of the forested east coast of North Borneo were turned into tobacco plantations. However, there are no statistics to show how many immigrants came into the country then, and, except for the Bau area, much of this early landscape has disappeared.

In response to the demand for Chinese settlers, there was another influx of Chinese immigrants in the nineteen-twenties and nineteen-thirties. However, the initial satisfaction at the success of immigration turned to mounting apprehension in the late thirties when there were many more arrivals than the labour market required. Immigration restrictions had to be imposed and many were repatriated so that in some years emigration exceeded immigration (Tables 1 and 2).

TABLE 1: NUMBER OF CHINESE ARRIVALS AND DEPARTURES AT KUCHING AND SIBU, 1930 TO 1937

YEAR	IMMIGRATION	EMIGRATION	
1930	6,928	10,680	Slump
1931	4,135	7,593	Years
1935	8,830	5,170	
1936	8,955	6,370	
1937	14,108	6,982	

Source: Sarawak Administrative Reports, 1929-38.

TABLE 2: NUMBER OF CHINESE ARRIVALS IN NORTH BORNEO 1927 TO 1939

YEAR	STATE ASSISTED	UNASSISTED
1927	866	—
1928	1,278	2,724
1929	1,067	2,967
1930	1,157	2,882
1931	395	1,519
1932	92	1,086
1933	187	2,315
1934	643	3,307
1935	667	3,837
1936	395	4,577
1937	493	7,912
1938	745	3,342
1939	263	1,992

Source: North Borneo Annual Reports, 1928-39.

The Second World War brought immigration to a halt. After the war, restrictions were tightened when the political situation demanded a different policy towards the entry of Chinese.

Nevertheless, the immigration of the Chinese has led to certain changes in land use, especially in the coastal plain areas which are the zones of contact between the Chinese and the indigenous peoples. One of the more obvious changes is the appearance of towns in this contact zone. All are Chinese in character and act as important collecting centres for the produce of surrounding areas. In the rural areas the Chinese have introduced new crops such as rubber and pepper, together with their homestead type of settlement. Their smallholdings of rubber, pepper, padi, coconut or orchards, and their dispersed houses form a new pattern in the Kuching-Bau-Serian area, in the Lower Rajang area, in the Sandakan area, and along the west coast of North Borneo. Since the majority of the Chinese settlements are located between the coastal Muslim indigenous peoples and the inland hill peoples there is much contact with both these groups, and the juxtaposition of Chinese and indigenous settlements is common. In some instances, such contacts have led to the introduction of new commercial crops by indigenous farmers, resulting in new land-use patterns within the indigenous smallholdings.

(iii) *Development of communications*

The immigration referred to above has been accompanied by the development of a system of communications which has also helped to change the character of the land use. Considerable development and change in land use have taken place along the roads between Kuching and Bau, Brunei Town and Tutong, and between Jesselton and Kota Belud. The North Bornean railway (completed in 1905), has also facilitated the introduction of rubber and the penetration of the Chinese into the interior. Rubber estates and Chinese smallholdings and their associated settlements form a new pattern of land use along these lines of communications.

In North Borneo, both the roads and the railway pass through the main rubber and padi lands of the country bringing the indigenous peoples nearer to administration and modernizing influences. They also bring the immigrant and indigenous peoples into close contact with each other. Unlike Malaya, where the traditional padi fields are in the north-west and north-east of the country so that the Malays and their economic activities are separate from and not in direct conflict with those of the immigrant peoples, in Borneo the immigrants and the rubber estates are adjacent to the indigenous peoples and their padi fields. It is, therefore, difficult to draw any line dividing immigrant from local population. Whether or not this situation will lead to a conflict of interests remains to be seen. The fusion of the two groups, without the restrictions of the Muslim religion, might be a peaceful solution.

The economic development of the western coastal areas of British Borneo owes much to the railway and the roads. Both have made the region the best developed and most urbanized part of the country. Development in the interior has been severely retarded by the lack of good communications. Thousands of acres of good agricultural land and timber forests have remained inaccessible or unexplored; indigenous tribes have remained isolated in the interior; and the administration has been unable to keep close contact with the people under its charge. It has been amply demonstrated that whenever a road is constructed, land on both sides is immediately taken up by settlers and cultivated: the Kuching-Serian, Kuching-Bau, Brunei-Tutong, Brunei-Muara, Bukit Manggis, Jesselton-Kota Belud and Sandakan-Beluran roads are some examples. The earth roads linking Tenom to Keningau and Tambunan, and Tenom to Kemabong are also rapidly attracting Chinese settlers, a fact which may lead to the early development of that part of the interior of Borneo.

Until further roads are constructed development will be confined to the following few pockets of territories where lines of communications are relatively better developed: Kuching and Bau Districts; Brunei District; the west coast of North Borneo; and the Central High Plains. Although it is recognised that the task of improving communications in the country is tremendous, easy and quick communications are important requisites to economic development.

OTHER CHANGES AFFECTING LAND USE

In addition to changes in the community life of the people, other influences are at work modifying land-use and settlement patterns to some extent.

(i) *Changes in land tenure*

Firstly, a new kind of land tenure phenomenon has arisen which land experts call 'Tertiary Land Tenure' (4). It occurs when a group of people, who

are not necessarily related, voluntarily join together, or are forced to unite by order of the Government, to exercise land rights in common. Most of the recently established Settlement Schemes in British Borneo come under this form of tenure classification.

(ii) *Settlement schemes*

All over the country Settlement Schemes are in progress. Although not all were initiated with identical aims, most are concerned with the extension of agriculture. In Brunei, for example, the Resettlement Schemes were started primarily to persuade people from Kampong Ayer (the river village and original Brunei town) to settle on land as cultivators. Under the Development Plan of 1956 three resettlement schemes have been put into operation, (i) in the Berakas Area, (ii) in the Simpang Muara Area and (iii) in the Jerudong Area (5). As yet, the Jerudong scheme has not attracted many settlers because no monetary subsidies are given, whereas, because of monetary inducements, all land in the Berakas and Simpang Muara areas has already been allocated to settlers. But in Brunei land settlement for agriculture has so far made little headway as preliminary surveys are still in progress.

In Sarawak, settlement schemes have been confined to the Chinese, and attempts to resettle the Land Dayaks have failed. Successful schemes for the Chinese can be seen at Sungei Beluboh in Luak Bay near Miri, Sungei Sibiew near Bintulu, and in the Bakong area of the Baram (6). The demand for land is greatest near the main centres of the Chinese agricultural communities where there is much under-employment despite the availability of local capital for opening new lands. The Government recognizes the urgency of making more land available for settlement. But in spite of the encouragement given by the Government and the willingness of the settlers themselves to take up new land further afield, there has not been any marked acceleration in the rate of land settlement. On the contrary, progress seems to have been slowed down by the problem of land re-distribution (7). Any land suitable for permanent agricultural settlement is already held, at least in part, under native customary rights, and is generally classified as native area land (8). In order, therefore, to proceed with land settlement the preliminary task of ascertaining the extent of lands under customary rights, and of assessing the needs of the native village and community has to be undertaken.

In North Borneo, the same problems and difficulties confront land settlement (9). However, compared with the other two territories, it has proceeded faster here, and ten settlement schemes have already been established mostly in the Keningau, Tenom and Papar Districts. There is also a greater variety of land settlement schemes, and, unlike those in Sarawak and Brunei, they are not confined to any one ethnic group. Two settlement forms offering security of tenure at low annual rents will emerge out of these schemes, one associated with the indigenous population and intended to persuade shifting cultivators in the hills to take up sedentary farming in the plains, and the other associated with the Chinese and concerned with rehabilitating illegal squatters on company estate land who face eviction. Many indigenous people, attracted by additional monetary subsidies, which are denied the Chinese, have come down from the hills to try this new way of life. The Chinese, however, left to work on their own resources, have tended to show little enthusiasm and response.

(iii) *The growth of a cash economy*

The introduction of cash crops into the native economy, or the transition from a subsistence to a cash economy, has led to some changes in the land use

without substantially modifying the indigenous settlement patterns. Thus, for example, the Melanaus[1] who in the past produced sago on a subsistence basis are now producing sago for sale, but neither their holdings nor their houses have changed very much. On the other hand, in most of the holdings of padi planters (both wet and dry) there has been a significant change in the land use with the introduction of rubber gardens amongst the padi fields. Settlements, however, have not changed to any appreciable extent, except in the case of the Sea Dayaks where long-house communities have often split because of quarrels over the siting of long-houses. When a long-house is to be re-built, individuals who own rubber lands insist that the building should be sited as close to their rubber gardens as possible. Since this may sometimes conflict with the wishes of other long-house dwellers, quarrels arise which may eventually result in a break-up of the community.

The planting of rubber on an estate basis has affected land alienation. The character of this crop and the desire to attract outside capital has, in the past, especially in North Borneo, demanded freehold or long leases. Many large estate concessions, however, are not yet fully exploited because not all commercial companies have the necessary resources to work the enormous areas granted them. And, since it is forbidden to develop these estate lands and concessions for food crops, it seems that plantation landscapes of commercial crops and forests, with their associated settlements, will remain for a long time. The indiscriminate granting of freehold title and long leases has had serious detrimental effects in certain parts of the country, in that it has hindered the Government's planning for agricultural development.

(iv) *Mineral wealth and changing landscape*

Finally, the discovery of oil has had a great impact upon the economy and landscape of Brunei. More than 30 per cent of Brunei's revenue comes from oil royalties, and the export value of crude oil makes up more than 90 per cent of the total value of exports each year. Most of the oilfields are located along a coastal strip between the 'oil towns' of Miri, Lutong, Kuala Belait and Seria. The population patterns of the areas where oil is worked have changed as a result of the influx of immigrant labour as well as workers from other parts of British Borneo. In addition to changes along the coast in the immediate vicinity of the oilfields, the exploitation of oil has indirectly influenced the land-use patterns of other parts of Brunei. Revenue from oil makes it possible for Brunei to finance a Development Plan covering the entire State. Thus new roads, settlement schemes, ports, airfields and new padi fields are appearing to form part of a fast changing landscape.

On the other hand, the discovery of oil resources and the envisaged port development at Muara has made it imperative that the Government should institute a careful survey of available land for further resettlement. Such industrial development as oilfields and port construction involve problems of land acquisition, resettlement of the evictees, and, in addition, considerable areas of State Land must be found for resettlement as a matter of urgency.

SOME RESULTANT LAND-USE TYPES

The following sections attempt to provide sample studies of land use which exemplify some of the changes outlined in the preceding discussion. The first

1. The Melanaus are found in the large deltaic swamp region between Bintulu and Rajang — in the coastal areas of the Third and Fourth Divisions of Sarawak.

illustrates the situation in those parts of the country not affected by recent immigration, and where new kinds of crops have not, as yet, been introduced. The second is characteristic of areas penetrated by Chinese who have established their own pattern of smallholdings. The third is typical of areas favoured by relatively good communications, where recent immigration has occurred and new crops have been introduced.

In the absence of adequate topographic maps, extensive use has been made of aerial photographs, the interpretation of which has been confirmed, as far as possible, by the author's personal observations in the field.

(i) *Indigenous land use in the Keningau and Tambunan Plains*

The monotonous landscape of forested hills and mountains in North Borneo is broken by a series of highland plains known as the Central High Plains. They lie to the east of the Crocker Range and stretch from Ranau to Kemabong. The Keningau and Tambunan plains belong to this series.

Although both areas have the appearance of plains they are in fact exceptionally wide sections of the Pegalan river valley. Keningau, the larger of the two, is 100 square miles in area and 1,200 feet above sea level, whereas Tambunan is approximately half that size and at an altitude of about 1,900 feet.

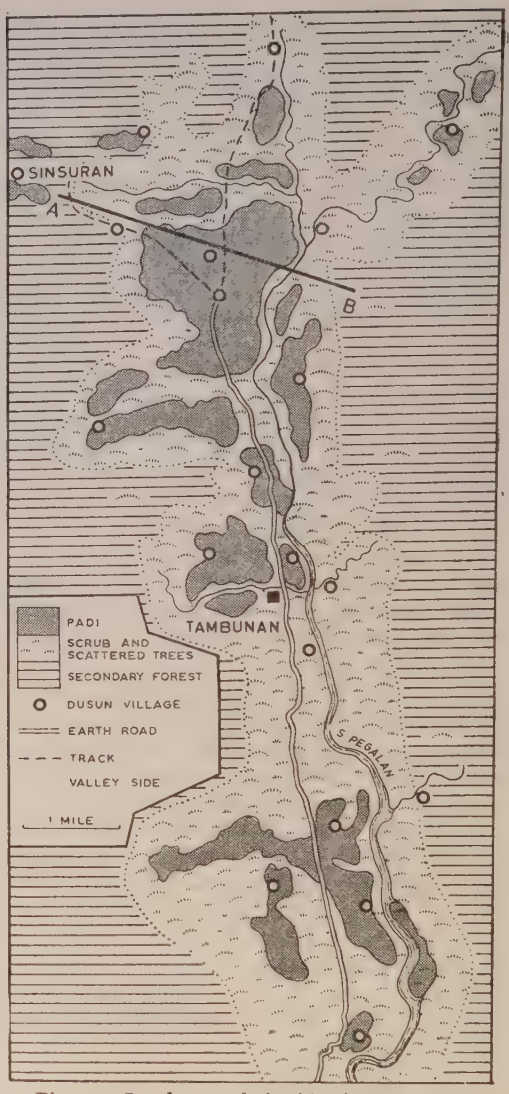


Fig. 3. Land use of the Tambunan Plain.

Two types of land use may be distinguished — that associated with the uplands and that of the plains. The uplands surrounding the plains are covered with thin stands of secondary forest and patches of shifting cultivation in varying stages of regeneration. Shifting cultivation is particularly extensive in the Tambunan uplands, and completely denuded hills stand out prominently on aerial photographs.

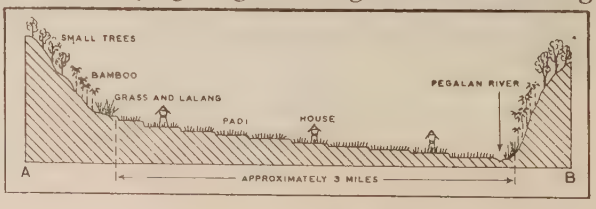


Fig. 4. Section across the Tambunan Plain. For exact location see Fig. 3.

In the Tambunan plain (Figs. 3 and 4), all forest vegetation has been cleared and a large part of the flood

plain is under wet padi (4,000 acres). In the less fertile portions, and along the lower slopes of the hills, large clumps of bamboo tend to compete with padi.

In the Keningau plain (Fig. 5) the forest vegetation has also been cleared by the successive phases of shifting cultivation, although only a small proportion of the plain has been planted with wet padi (3,200 acres). Most of this plain is covered with low shrubs two or three feet high and scattered stunted trees fifteen to twenty feet high, giving it the physical characteristics of savanna country. Conditions here are such as to make it a potential cattle rearing region. Favourable factors include the cool temperature, large areas for establishing pastures and the road and rail linkages with the west coast markets. However, as the Government is at present preoccupied with padi production and the question of self-sufficiency in rice, the rearing of cattle is not a high priority, though an experimental cattle station has already been established, and the results so far are encouraging. Cattle grazing areas, however, will have to be confined to the less fertile portions of the plain leaving the more fertile soils for padi growing. There is a marked correlation between soil conditions and padi areas. The soil map of Keningau shows that padi is found only on the more fertile recent soils, or on the immature soils derived from fluviatile alluvium. Scrub-land covers the infertile areas of podsolized soils, talus soils and tropical red and yellow soils, but there are still large areas of land that could be brought under cultivation.

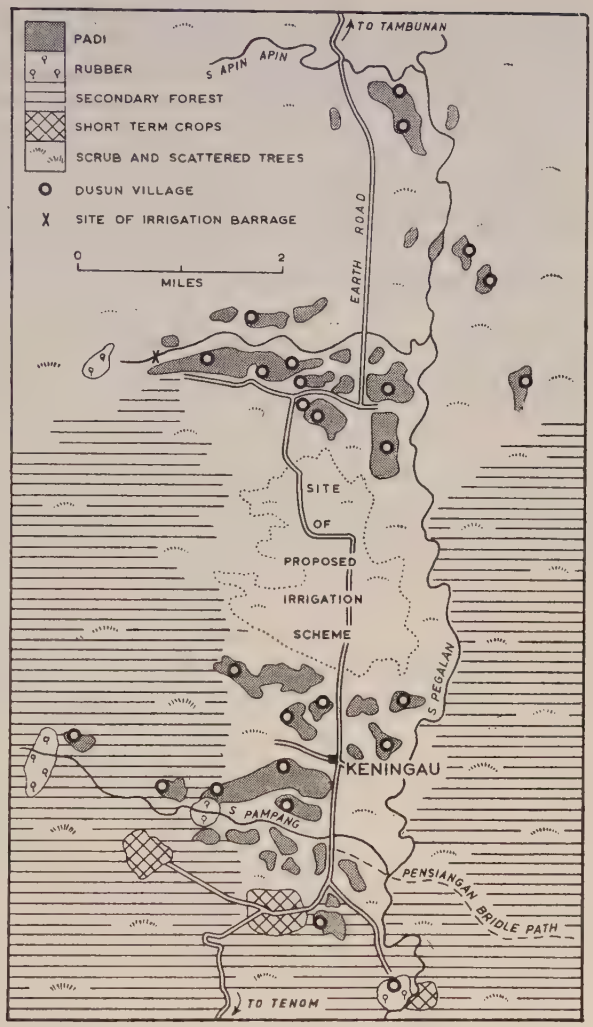


Fig. 5. Land use of the Keningau Plain.

Padi fields are now the dominant feature of the plains. Only when the Chinese penetrate further north will the land use take on a more variegated pattern. The four or five patches of rubber and short term crops (soya beans, maize, groundnuts, coffee, vegetables and fruits) in the southern part of the Keningau plain mark the northward encroachment of the Chinese into indigenous territory. Over 95 per cent of the population in both these plains is indigenous, practising either

wet-padi or some form of dry-padi cultivation. Terraced padi fields are common in the Tambunan area but not in the flatter and larger Keningau plain.

Settlements in the hills are often nucleated, due partly to the absence of flat ground, and each nucleated village has a distinct name. On the plains, houses are dispersed or in clusters of two or three adjacent to the padi fields, and village names generally refer to a wide area which includes both fields and scattered houses. Another feature of the Plains is the existence side by side of sedentary and shifting cultivation. As yet there are no Chinese rural settlements. Chinese are found mainly in the two small towns of Keningau and Tambunan,

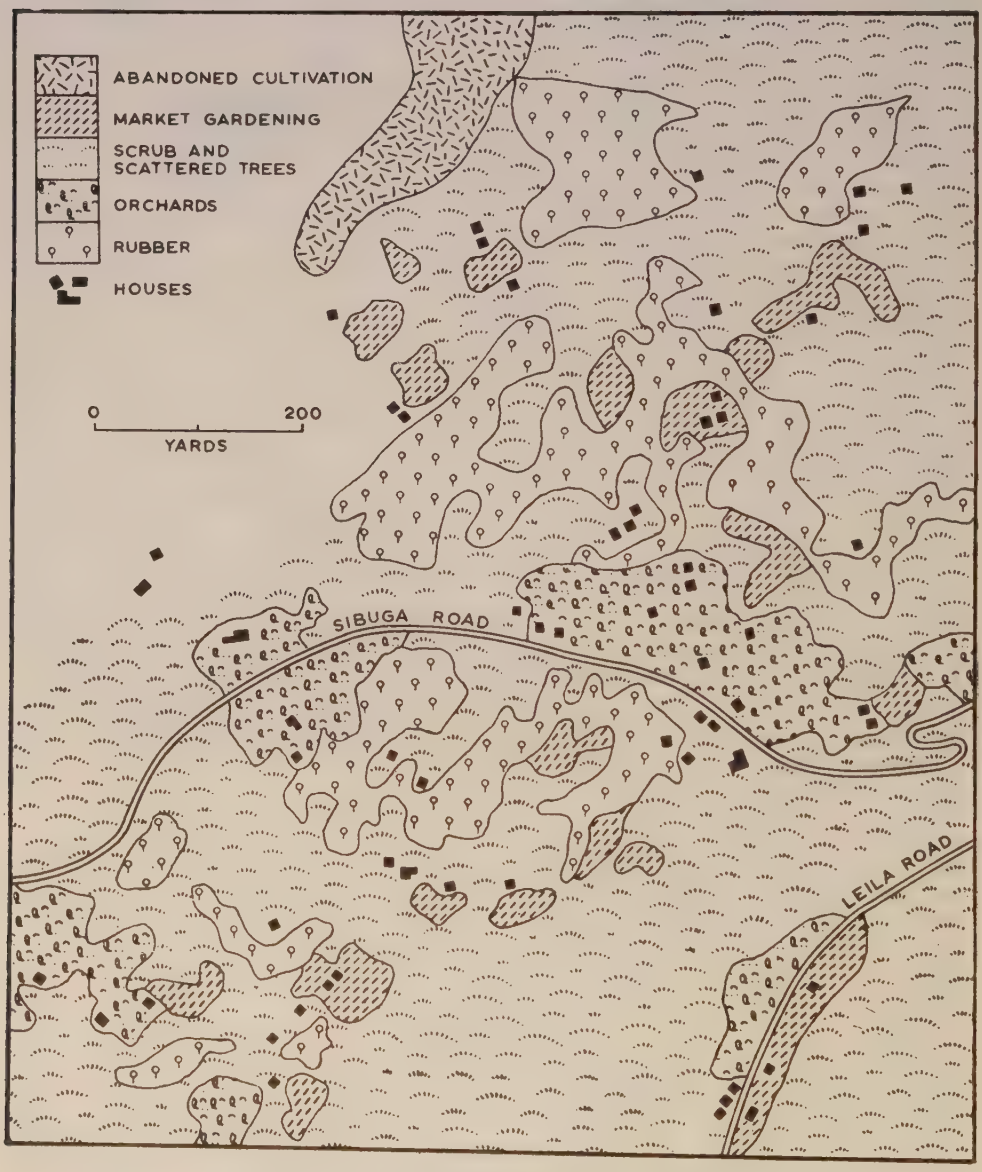


Fig. 6. Land use and settlement in a Chinese smallholding area.

and a few in the southern part of the Keningau plain. It is inevitable that, with the encroachment of the Chinese onto the plains, the settlement pattern will eventually resemble that of the coastal areas where immigrant and indigenous settlements and land-use patterns are found side by side.

(ii) *Land use on immigrant Chinese smallholdings*

Typical Chinese smallholdings occur in the coastal area of Sandakan where sandstone hills impinging upon mangrove swamps severely restrict the development of arable land. With careful terracing and good management, the Chinese peasants have established a series of small orchard-like plots. Soil conditions, as well as topography, are best suited to permanent tree crops such as rubber, coconut and other fruits. In this orchard type of cultivation on hilly terrain, houses and pathways follow the contours, and from the air the impression is one of apparent haphazard development. Population is sparse in areas above 200 feet, and patches of formerly cultivated land are now under scrub. These conditions are particularly evident in the area immediately north and north-west of Sandakan town.

Figure 6 represents the land use along a hilly section of the Sibuga Road. To the north of the road the land is occupied by smallholders who raise subsistence crops and tap small patches of rubber. On the south, where the hills rise to 300 feet, is an old settled area whose soil has become impoverished by repeated cropping. A large proportion of this area is abandoned scrubland with a scanty and stunted tree growth.

Figure 7 illustrates the conditions along North Road which runs between

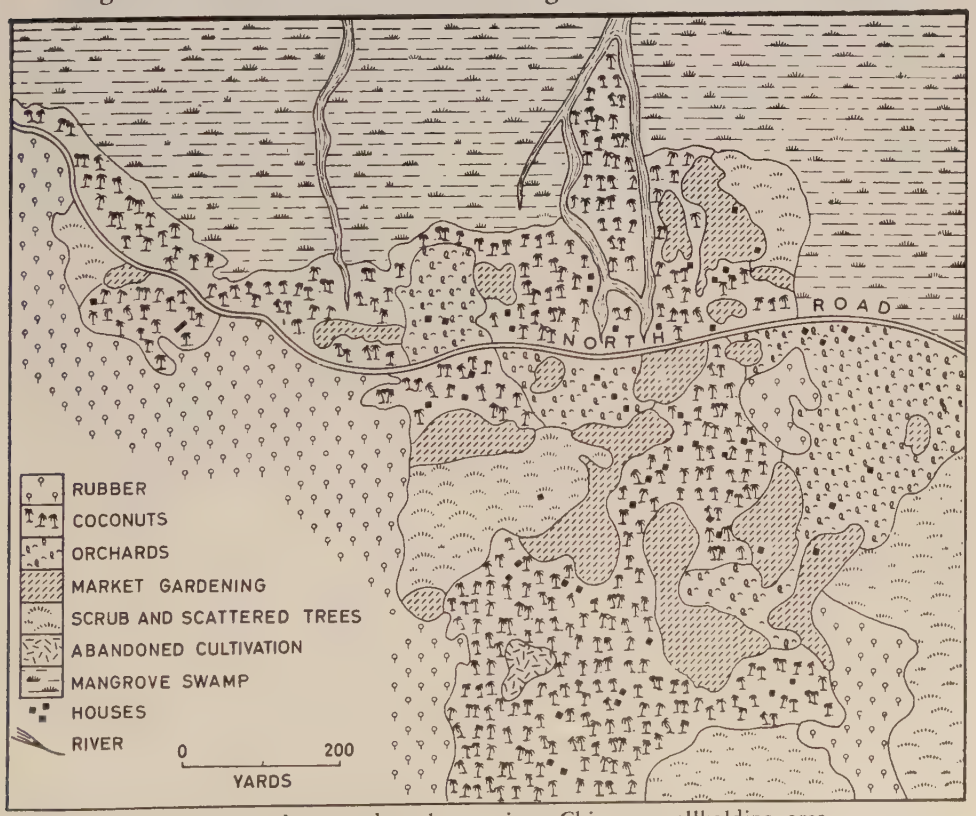


Fig. 7. Land use and settlement in a Chinese smallholding area.

cleared mangrove land and hilly ground further inland. The reclamation of swamp land is the work of pioneer Chinese smallholders. The coconut palm is characteristic of the low-lying parts adjacent to the swamps, whereas the hills are planted with rubber. In addition, there are considerable areas of subsistence cultivation and fruit trees.

The above examples are typical of the land-use and settlement patterns of Chinese homesteads in British Borneo. Such pioneer settlements are frequently encountered in close proximity to forests and shifting cultivation. But, there are also Chinese farms to be found along the main roads of the country and close to the towns. Whenever they occur the farms are always small and characterized by patchiness, a wide variety of crops and scattered houses. The haphazard appearance of Chinese farms is due partly to the Chinese individualistic trait, and partly to a land tenure system which permits land to be parcelled off to individual families on application. Most of the 'Mixed Zone' of Sarawak, except for five estates, is almost wholly composed of Chinese homesteads.

(iii) *Contemporary development in land use in the Papar District*

The Papar District exemplifies the land use of the western coastal plain where modernizing influences have had their greatest impact (Fig. 8). Economic development and cultural contacts began early here. Historically this area is interesting because the first attempt at colonizing North Borneo was made at Kimanis, by Americans in 1866. Chinese colonizers also came to this area from Labuan in the eighteen-forties.

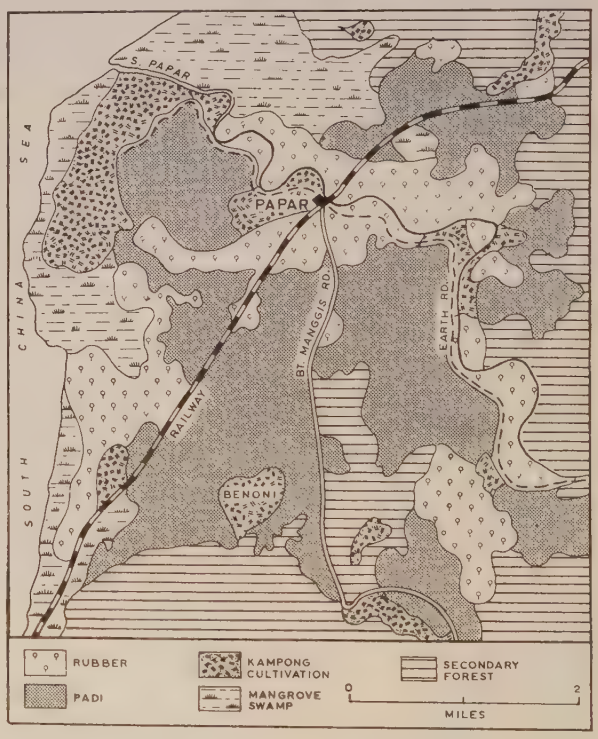


Fig. 8. Land use around Papar town.

Despite early contacts with the outside world, agricultural and economic development are still confined to the coastal plain. The rest of the district is occupied by the forested Crocker Range and its foothills. The coastal plain varies in width from five to ten miles, and contains all the cultivated land of the area. It is almost flat, but more than three quarters of the plain is still not cultivated. Lowland tropical rainforest covers the greater part of the plain especially in the south. Scrub-like vegetation of grass, shrubs and bushes, and scattered trees occupy the sandy coastal margins and mangrove swamps extend inland for some distance. This low-lying land is liable to annual floods.

A very large proportion of the district is inaccessible except by rivers and footpaths. The railway which runs along the coastal beaches is the only major line

of transport and communication, and, since there are only thirteen miles of metalled road, there is a great dependence upon the railway for communication between districts. The lack of roads has held up agricultural extension. The proposed extension of Bukit Manggis Road from Papar to Kimanis has led to a demand for land bordering the road for cultivation. Chinese smallholders are now clearing large areas on the steep slopes along Bukit Manggis Road.

Less than 20 per cent of the area is under cultivation. Rubber occupies 50 per cent and padi 40 per cent of the cultivated land. Rubber is the most important single crop, the five estates in the district account for most of the 20,000 acres devoted to it. On the land-use map these estates appear as five isolated patches. There is also a narrow discontinuous belt of smallholding rubber along the levees of the Papar River. All the estates are strung along the railway, and most of them are on rolling country where the soils are tropical red earths derived from sandstone and shale. Most of the Chinese smallholdings, also sited on soils of this kind, vary in size from 5 to 100 acres.

Wet padi is cultivated on the valley flats, where soils are immature and derived from fluviatile alluvium. There is, however, only one large padi area made up of contiguous fields, located near Papar town (Fig. 8). Elsewhere, padi fields form scattered patches bordering the lower courses of the main rivers. In terms of numbers of people involved, this is the most important category of agriculture. It is purely subsistence and most of the farmers are Dusuns, with a few Bajaus, Bruneis and Chinese. It is estimated that about 8,000 acres are under padi, supporting approximately 1,500 families. Plots are small, varying from two to fifteen acres with an average size of about five acres. In the highlands, scars on the forested slopes bear witness to the presence of shifting cultivation.

On the coastal plain three different types of settled agriculture therefore exist side by side — padi, rubber estates and smallholdings. In spite of the multiplicity of land-use and tenure patterns in this zone, they are somewhat inter-dependent. Most of the peasant farmers, for example, work as labourers in the estates during the off season, and because of the general shortage of labour in the country the estates are very dependent upon such casual labour. Estate settlements are nucleated and the density low. The density of settlement is greater in the padi fields and in the rubber smallholdings where houses are either scattered singly or in twos and threes over the entire cultivated area. But there are large uncultivated areas still under forest, reflecting the slow economic development of the country, as well as the lack of population, capital and roads which are necessary before any major changes can take place.

The land-use pattern of this region is typical of all the coastal districts of British Borneo. It is the pattern that took shape in the first three decades of the twentieth century, when rubber was the only major source of revenue in this part of the world. Nevertheless, the present land-use pattern does reflect changing economic conditions, and is quite different from the pattern which existed when Borneo was a series of independent riverine territories, and when land use was restricted to small plots of subsistence cultivation about the estuaries, and the means of livelihood was confined to fishing, piracy and the collection of jungle produce.

CONCLUSION

The examples of different land-use types discussed above focus attention upon the various factors affecting the development of land use in British Borneo.

In particular, attention is drawn to the impact that rubber has had upon the landscape. For most parts of the country the introduction of rubber resulted in a closely knit three-fold pattern of land use — (i) commercial plantations; (ii) Chinese rubber smallholdings and (iii) indigenous padi farms, both for direct subsistence, as well as a source of food for estate workers. This three-fold pattern has shown little change except in areas where Chinese have begun to grow crops other than rubber. The only region where the three-fold pattern is not found is the east coast where the pattern is one of isolated mono-crop units of various commercial crops.

The simplicity or multiplicity of the pattern of land use is dependent upon the extent to which the area has been penetrated by the Chinese, commercial crops, roads, railways, and other forms of capital enterprise. The Keningau and Tambunan areas are examples of a simpler system of land use, whereas in the Papar area there is a blend of all systems.

In areas with new land-use patterns, new settlement types have also appeared. Plantations and commercial enterprise have introduced new settlement forms, but the largest contribution to settlement change has come from the Chinese. Wherever they have gone their settlements, smallholdings and towns have appeared. Often they form the vanguard of pioneering forces within the country. Consequently, many Chinese homesteads are adjacent to settlements of shifting cultivators.

It would appear that further changes in the land use will result from agricultural expansion. The occurrence of oil is confined to a narrow littoral strip and its exploitation has affected the settlement and land use of only a few coastal towns. Sufficient is known of the geology of the area to be confident that future oil workings will be restricted to the coast, and will therefore involve only a small part of the country. Recently, agricultural expansion in the form of settlement schemes has appeared. The expanding Chinese rural population has been brought together to form agricultural colonies, and semi-nomadic indigenous peoples have been resettled in agricultural communities.

If there is to be effective land-use planning in the future, then it is apparent that many of the factors affecting land use discussed above have to be taken into account. As population expands, conflicts will inevitably arise within the triangle of settled agriculture, shifting cultivation and forests. Certain aspects of such conflicts are already evident in the movements of the Sea Dayaks and the setting up of Forest Reserves to restrict their wanderings, the coming of the Chinese, and the development of communications. The introduction of cash crops and the setting up of settlement schemes are but other facets of the same problem. Shifting cultivation must be replaced by alternative and better forms of agriculture. These are some of the factors which will prove significant in future land-use planning as they will determine how the proportions of the country under the three kinds of land use will change.

With such a complex and growing set of forces operating to change the present land-use patterns, an obvious need, in order to plan for future agricultural development, is a more thorough knowledge of the physical factors of the environment. Detailed soil surveys, climatological maps and land potential maps must be prepared. If such surveys are carried out, and coupled with the analysis of the diverse forces affecting agriculture today, British Borneo should be able to make successful plans for its future economic development.

REFERENCES AND NOTES

1. Native titles are granted in perpetuity and may not be sold to non-natives. Such lands are passed on through inheritance and very rarely do they fall into the hands of non-indigenous people. However, instances have occurred of native land being transferred to aliens, as Monica Glyn-Jones discovered in the Penampang area. She suggests that former areas of native land have become Chinese property through marriage. See Monica Glyn-Jones, *The Dusun of the Penampang Plain in North Borneo* (mimeo 1953), p. 15.

2. This area falls within the administrative unit called the 'Second Division'.

3. The migration into the Rajang area from the Second Division river valleys coincided with Brooke's repeated attacks on the Sea Dayak strongholds up these valleys. At this time the Sea Dayaks and the coastal Malays were the main culprits responsible for the anarchy which wracked the country. Against Brooke's wishes the Sea Dayaks continued to practice head-hunting and engaged in inter-tribal warfare and in piracy. Brooke despatched numerous punitive expeditions to curb this lawlessness and to punish them for other offences. The Sea Dayak's alliance with the Malay pirates was broken by this offensive, and large numbers of them migrated up the Second Division rivers and then into the Third Division rivers of Katibas, Kanowit, Entabai and Julau — southern tributaries of the Rajang. The renewed Government offensive against the recalcitrant Sea Dayaks in the eighteen-fifties led to further migrations into the Rajang area.

4. Clauson, Gerard, *Communal Land Tenure,* F.A.O. Agricultural Studies No. 17 (Rome, 1953), p. 6.

5. (i) Berakas Settlement Area comprises 44 acres near Brunei airport, where settlers are given quarter-acre lots. This scheme is intended for people who do not wish to become cultivators but to continue in their normal employment.
   (ii) The Simpang Muara Area covers 700 acres four miles from Brunei Town. Two-acre lots are provided for each settler family and a little cultivation is possible.
   (iii) The Jerudong Settlement Scheme lies between the main Brunei-Tutong Road at Jerudong and the sea. Settlers here are given one or two three-acre lots.

6. (i) In Sungei Beluboh more than 1,000 acres of forest have been felled. Lots have been taken up by more that eighty Foochow families who have erected individual homesteads and planted mainly rubber.
   (ii) Sungei Sibiew is a 4,000-acre settlement scheme. Over 2,500 acres have been cleared for rubber and interim crops of padi and maize have already been harvested.
   (iii) So far 2,000 acres of land suitable for rubber planting have been selected in the Bakong area for settlement.

7. *Sarawak Annual Report, 1957* (Kuching, 1958), pp. 31 and 32.

8. Sarawak is divided into four zones (i) Mixed Zone, (ii) Native Area, (iii) Reserves and, (iv) Interior Area and Native Customary Land. Native Customary Land is not so closely administered as Native Areas, it is distant from population centres and reserved for, and principally occupied by, indigenous people. See *Sarawak Annual Report, 1959* (Kuching, 1960), map facing p. 40.

9. Lee, Y. L. 'Land Settlement for Agriculture in North Borneo', *Tijdschrift voor Economische en Sociale Geografie,* Vol. 52, No. 7, July 1961, pp. 184-91.

THE POPULATION OF MALAYA
SOME CHANGES IN THE PATTERN OF DISTRIBUTION BETWEEN 1947 AND 1957 (1)

By KERNIAL SINGH SANDHU

INTRODUCTION

MALAYA[1] HAS a multi-racial population including Malays, Chinese, Indians, Europeans, Eurasians, Sinhalese, Arabs, Jews, Siamese, Aborigines and others. The first three communities, however, are the dominant groups, forming 97 per cent[2] of the total population. Apart from the Aborigines the population is essentially alien in character, being composed predominantly of Malay, Chinese and Indian immigrants, or descendants of such immigrants, who moved into the country consequent upon its being opened up during the last one hundred years (2).

The movement of these immigrants into Malaya resulted in several major changes in both the population structure and the human geography of the country. In the first place the Aboriginal population of Malaya was either gradually assimilated by the Malays or pushed from the coast into the interior. Today there are only about 100,000 Aborigines in Malaya mainly in the remote interior of the country (3).

Secondly, the influx of Chinese and Indian immigrants has substantially changed the racial composition of the population. As early as 1921 'alien immigrants'[3] already outnumbered the Malays, making the latter a minority in their own country.[4] By 1957 there were more Chinese than Malays in Malaya. The Malays are the largest community only in the Federation, the population of Singapore being overwhelmingly Chinese.

Thirdly, a remarkable transformation has also occurred in the development of the country. A century ago the settled parts of Malaya consisted merely of a few clearings around the coast, along the rivers and isolated patches in the forests and swamps. Production was restricted to some foodstuffs and jungle items. Yet today it is one of the richest and best developed countries in Asia, producing more than a third of the world's supply of tin and natural rubber, as well as large quantities of palm oil, copra and pineapples.

1. Unless otherwise stated, the term 'Malaya' is used in the text to include both the Federation of Malaya and the State of Singapore.
2. This figure also includes immigrant Indonesian and other Malays who have been traditionally classified with the indigenous Malays in the population censuses of Malaya.
3. The Indian and Chinese immigrants were regarded as 'alien immigrants' in Malaya, and were generally denied most of the citizenship privileges enjoyed by the Malays until after the Second World War.
4. Though in fact being immigrants of only a little longer standing than the Indians or the Chinese, the Malays have been habitually and in constitutional theory and political practice accepted as 'natives of the country' and 'owners of the soil'.

Fourthly, as a result of immigration, especially in the earlier stages, the population of Malaya increased rapidly. Later on, with the improvement in sex ratios, the pace was maintained through natural increase. By 1957 the population numbered 7,724,690 persons, giving a density of 152 persons per square mile. Overall density figures in Malaya are, however, of little significance, since large parts of the country are still virtually uninhabited while in others the distribution is very uneven (Tables 1 and 2). This disparity was significantly accentuated by several changes that occurred in the urban and rural patterns of distribution between 1947 and 1957.

GENERAL PATTERN OF DISTRIBUTION OF THE TOTAL POPULATION 1947 TO 1957

To appreciate fully the recent changes in Malaya's population a brief analysis of the historical evolution of its pattern of distribution is necessary. In this the surface configuration and the natural resources of the country have played an important role.

Physiographically Malaya consists of a densely forested central belt of mountain ranges flanked by a well-drained foothill zone, in many places cut off from the coast by large stretches of freshwater and mangrove swamp. Movement in the swamp covered coastal lowland was difficult, and, until the advent of roads and railways, the swamps were a formidable barrier to interior penetration. Transport, in the early days, was limited to small boats along the rivers. While generally unattractive to other immigrants, the lowlying water-logged alluvial coastal stretches, particularly those in comparatively more sheltered and accessible Western Malaya, had high potentialities as padi and fishing areas for the Malays.

The interior foothill zone consists of two sections, an eastern and a western. The latter is the widest and economically the most important. It is comparatively more accessible and contains the main tin bearing formations of the country. In addition, its well-drained gently rolling topography lends itself to the cultivation of commercial crops such as rubber and oil palm. It is thus not surprising that it was this region of Malaya that appealed most to the non-Malay immigrants. The major portion of the population of Malaya today is in this region.

Repelled by the forbidding forested interior, the Malays were content to remain in coastal and estuarine settlements and eke out an existence through fishing, agriculture, trade and, if needs be, piracy. The Chinese, on the other hand, attracted by the rich tin deposits of the western foothill zone were already moving into the interior by the middle of the nineteenth century. Subsequent to the British occupation of the Federated Malay States in the eighteen-seventies, railway lines were built to link up the pioneer mining settlements with the ports and with each other. With the rapid spread of large scale mining activities along this railway network the concentration of population shifted from the coast to the western interior foothills. Furthermore the railway network encouraged extensive agricultural developments.

Hampered by the lack of suitable land in the Straits Settlements, planters flocked into the Malay States as soon as British rule was established there. Initially experimenting with sugar and coffee, these planters began, in the eighteen-nineties, to grow rubber as a plantation crop close to the original centres of immigrant activity, in the western foothill zone. The rubber tree was unsuited to the lower temperatures of the highlands or the soggy soils of the swamps. The foothill zone had the advantage of good natural drainage, and, more important still, it had the existing railway network for communication and supplies, especially rice. Rice

TABLE 1: THE POPULATION OF MALAYA, GROWTH AND RACIAL COMPOSITION, 1911 TO 1957

YEAR	ADMINISTRATIVE UNIT	TOTAL POPULATION	RACIAL COMPOSITION AS A PERCENTAGE OF THE TOTAL			
			Malays[1]	Chinese	Indians	Others
1911	Federation	2,339,051	58.5	27.3	10.2	4.0
	Singapore	305,439	14.0	72.3	9.1	4.6
	Malaya	2,644,490	53.3	34.6	10.1	2.0
1921	Federation	2,906,691	54.0	29.4	15.1	1.5
	Singapore	420,004	12.9	75.2	7.7	4.2
	Malaya	3,326,695	48.8	35.2	14.2	1.9
1931	Federation	3,787,758	49.2	33.9	15.1	1.8
	Singapore	559,946	11.8	74.9	9.1	4.2
	Malaya	4,347,704	44.4	39.2	14.3	2.1
1947	Federation	4,908,086	49.5	38.4	10.8	1.3
	Singapore	940,824	12.3	77.6	7.3	2.8
	Malaya	5,848,910	43.5	44.7	10.3	1.5
1957	Federation	6,278,763	49.8	37.2	11.1	1.9
	Singapore	1,445,929	13.4	73.9	8.4	4.3
	Malaya	7,724,692	42.9	44.2	10.6	2.3

1. In addition to the Malays proper the figures in this column include Aborigines and immigrant Indonesian and other Malays.

TABLE 2: MALAYA, POPULATION DENSITIES

ADMINISTRATIVE UNIT	AREA IN SQUARE MILES	PERSONS PER SQUARE MILE				
		1911	1921	1931	1947	1957
Penang	400	695	761	851	1,116	1,430
Malacca	633	196	243	295	378	460
Perak	7,890	63	76	100	121	155
Selangor	3,166	93	127	168	225	320
Negri Sembilan	2,550	51	70	92	105	143
Pahang	13,873	9	11	13	18	23
Johore	7,321	25	39	69	101	127
Kedah	3,660	67	93	117	151	192
Kelantan	5,746	50	54	63	78	88
Trengganu	5,050	31	31	36	45	55
Perlis	310	109	133	159	227	293
Federation	50,600	46	57	75	97	124
Singapore	224	1,364	1,875	2,500	4,200	6,455
Malaya	50,824	52	65	86	115	152

was the staple food of the immigrant Indian labourers brought from India to work in the plantations, and it had to be imported. Rubber cultivation thus spread ribbon-like along the railway lines in the western foothills, confirming the new pattern of population distribution initiated by tin mining. Later on this pattern was further emphasized and extended as the plantations spread along roads constructed to serve the needs of the expanding industry. From the mid-western foothill zone pioneers gradually pushed north into Kedah and south into Johore as the railway lines were extended into these States.

Roads and a north-south railway line were also constructed in the eastern foothill zone. Consequently, this zone too began to receive new settlers in substantial numbers. But Eastern Malaya generally suffered from the disadvantages of isolation and inaccessibility, and the lack of the economic attractiveness of Western Malaya. The net result was that the greatest concentration of people developed in Western Malaya. In subsequent years this overall pattern of population distribution and economic development has not changed very much, the tendency has been for it to be accentuated.

In 1947, Malaya had a population of 5.8 million, of which nearly a million were on Singapore Island. Singapore, constituting less than 1 per cent of the total area of Malaya, had 16 per cent of the total population. By 1957 it had 18.8 per cent of the total population, principally as a result of a faster rate of annual increase than in the Federation. This lack of uniformity in the general distribution of population between the Federation and Singapore was also a characteristic feature of the pattern within each territory (Table 3).

The Federation of Malaya

The population of the Federation by 1947 was concentrated principally in the Western States of Perlis, Kedah, Penang, Perak, Selangor, Negri Sembilan, Malacca and Johore. Together they contained 81.2 per cent of the inhabitants of the country, the remainder being found in the Eastern States of Kelantan, Trengganu and Pahang (Table 3). Most of the people lived within forty miles of the coast, especially in mid-western and north-eastern Malaya. The former is the region of greatest development in mining, lines of transport and plantation agriculture, whilst the latter is one of the earliest settled areas of the Malay community. Within this peripheral distribution there were pockets of greater concentration, mainly in (i) the Kedah and Perlis padi plains of the north-west; (ii) the port-city and island of Penang; (iii) the intensely developed agricultural region of Province Wellesley and north-western Perak; (iv) the tin and rubber regions of Ipoh/Telok Anson and Kuala Lumpur/Klang, including the urban agglomerations of and around Kuala Lumpur and Ipoh; (v) the Malacca and west Johore coastal strip of rubber and padi cultivation; (vi) the Kelantan Delta padi region of north-east Malaya.

These places, in addition to being regions of intense economic development, have also had the advantage of the momentum of an early start, all of them have been centres of settlement from the beginning of the opening up of the country. The remote and forested mountainous interior has remained largely uninhabited, or sparsely populated in a few places (Fig. 1).

During the decade from 1947 to 1957 the above pattern of population distribution did not change significantly, except for a little more filling in of the newly developing areas adjoining the established centres of population concentration. The concentration of people in the Western States was slightly

Fig. 1. Distribution of Population, 1947.

Fig. 2. Distribution of Population, 1957.

TABLE 3: DISTRIBUTION OF TOTAL, URBAN AND RURAL POPULATION, 1947 TO 1957

FEDERATION OF MALAYA

	Total Population		Percentage of Total Population		Urban Population		Percentage Urban		Percentage of Total Urban Population		Percentage of Total Rural Population	
	1947	1957	1947	1957	1947	1957	1947	1957	1947	1957	1947	1957
Penang	446,321	572,132	9.1	9.1	250,940	366,882	56.2	64.1	19.4	13.8	5.5	5.5
Malacca	239,356	291,246	4.8	4.6	63,009	84,432	26.3	29.0	4.8	3.2	4.7	5.7
Perak	953,938	1,221,390	19.4	19.5	281,203	601,057	29.5	49.2	21.6	22.6	18.7	17.1
Selangor	710,788	1,012,891	14.4	16.1	272,531	611,553	38.3	60.4	20.9	23.0	12.1	11.2
Negri Sembilan	267,668	364,331	5.4	5.8	59,676	119,522	22.3	30.7	4.6	4.5	5.8	6.7
Pahang	250,178	312,949	5.1	5.0	35,998	127,651	14.4	36.0	2.7	4.8	5.9	5.2
Johore	738,251	927,565	15.0	14.8	166,781	378,211	22.6	40.8	12.8	14.2	15.8	15.2
Kedah	554,441	701,643	11.3	11.2	76,490	162,784	13.8	16.6	5.9	6.2	13.3	14.9
Kelantan	448,572	505,585	9.1	8.1	35,210	114,994	7.9	22.1	2.7	4.3	11.5	10.8
Trengganu	225,996	278,165	4.6	4.4	53,214	82,447	23.5	29.6	4.1	3.1	4.8	5.4
Perlis	70,490	90,866	1.4	1.4	6,324	8,620	9.0	9.5	0.5	0.3	1.9	2.3
Unlocated	2,087	—	0.4	—	—	—	—	—	—	—	—	—
Federation	4,908,086	6,278,763	100	100	1,301,376	2,658,153	26.5	34.4	100	100	100	100

SINGAPORE

			Percentage of Total Population of Malaya						Percentage of Total Urban Population of Malaya		Percentage of Total Rural Population of Malaya	
Singapore State	940,824	1,445,929	16.1	18.8	752,737	1,019,500	80.0	70.5	27.7	36.6	4.9	10.5

MALAYA (Federation of Malaya and Singapore)

Malaya	5,848,910	7,724,692			2,054,113	3,677,653	35.1	47.6				

further emphasized. By 1957 some 83.5 per cent of the Federation's 6,278,760 inhabitants were in this region, compared with 81.2 per cent in 1947 (Table 3 and Fig. 2).

The population of the Western States is increasing at a faster rate than that of the Eastern States. The west registered an increase of 30 per cent during the 1947-57 inter-censal period, compared with only 20 per cent in the east (4). Furthermore, the Government's plans to open up new areas, in its effort to give land to the landless and to diversify the agriculture (5, 6), appear to be concerned chiefly with the more accessible Western States. For example, of the eleven land development schemes in progress in 1959, eight were in the Western States. Seven out of a further eleven projects planned to start in 1960, and seven out of the ten schemes in the preliminary stages of planning, were all located in the west (7). When these schemes become fully operational they will lead to a denser settlement of the western parts of the Federation. However, with the Alliance Government's policy of 'spreading out' new development uniformly among the States during its Second Five Year Plan, there will be a greater development of, and settlement in Eastern Malaya (8). But the numbers of new settlers involved will not be so large as to cause a major transformation in the existing pattern of population distribution.

Singapore

Sixty-nine per cent of the total population of the Island in 1947 was within the city limits, with minor concentrations in the adjoining Katong and Serangoon suburban areas (9a). Other smaller concentrations were in the factory zone along the Singapore — Federation trunk road, and in the British military bases in the north and east of the Island (Fig. 1).

The above pattern of distribution did not change to any great extent during the ensuing ten years, except for an increase in the number of rural dwellers, largely at the expense of the city population. The proportion of the total population within the City of Singapore in 1957 was 63 per cent compared with 69 per cent in 1947 (10). This reflects the Government's attempts to develop rural Singapore in the post-war years. One example of the development was the establishment of numerous housing estates in the rural areas so as to relieve the congestion within the city. There was also the erection, outside the city area, of a number of factories, producing or assembling items ranging from biscuits to motor cars. Finally, there was the acquisition by the British Military Services of large tracts of land which were put to a variety of uses, such as airfields and cantonments (11). These developments led to a greater density of settlement in rural Singapore with the principal concentrations still located along the main trunk road and in the north-east and east of the Island. Emphasis upon rural development will continue with the full implementation of the Singapore Government's Master Plan, which is designed to relieve congestion within the city and to develop the rural areas (12).

THE URBAN AND RURAL[1] PATTERNS OF DISTRIBUTION

For a primary producer of raw materials, Malaya has been a highly urbanized country for the last fifty years. Twenty-three per cent of the country's population

1. There is as yet no satisfactory definition of the terms 'Urban' and 'Rural' which could be uniformly applied in any part of the world. In Malaya, for census purposes, urban areas are taken to be towns or large villages which have 1,000 or more inhabitants.

in 1911 was urban, and by 1947 it had increased to 35 per cent. In addition there was a good deal of what has been termed 'population clotting' in the food producing and dormitory areas around the towns. If these clusters were included in the urban population then the proportion of urban dwellers in the total population would have been even higher (9b). In comparison, about 15 per cent of the total population of South-east Asia was estimated to be urban in 1947, while only 10 per cent of Indonesia's population was classified as urban (13).

The high proportion of urban dwellers in the population of Malaya was further increased following the declaration of the Emergency in 1948.[1] The campaign against the communist bandits necessitated the movement of some 580,000 rural dwellers of the Federation into 536 nucleated settlements, called 'New Villages'. These were located along the main roads for convenience of administration, access and supervision (14, 15, 16). They varied in size; twelve of them contained 5,000 or more inhabitants; another 162 had between 1,000 and 5,000 dwellers (Table 4). In terms of numbers the resettlement programme, together with the normal growth of the population and the establishment of satellite and dormitory centres like Petaling Jaya in Selangor (17) and Princess Elizabeth (Housing) Estate in Singapore, increased the number of urban centres from 187 to 444, and the proportion of urban dwellers in the total population increased from 35.1 to 47.6 per cent (Tables 3 and 5). This represents an increase of 79 per cent in the total urban population of the country during the decade 1947-57, compared with the 60.3 per cent increase during the preceding sixteen year period of 1931-47 (9c) (Table 6).

Malaya is already the second highest urbanized country in Asia and the foregoing figures indicate the rapid progress of urbanization that is still taking place. This trend will, in all probability, be even more marked in the future. In the first place, there will be the normal growth of the existing urban population, which is increasing at a much faster rate than both the rural and the total population. This is particularly true of the Federation. For example, while the rural and the total population of the Federation increased by only 0.4 and 27.9 per cent respectively during the 1947-57 period, the urban section was more than doubled (Table 6). Secondly, attracted by the social amenities and economic opportunities of rapidly developing urban centres, the continuous drift of rural dwellers to the towns shows no signs of abating. Thirdly, the progress of industrialization is accompanied by the creation of an increasing number of industrial estates on the fringes of established urban centres like Johore Bahru (18), Kuala Lumpur (19), Ipoh (20), and Jurong in Singapore (21). Many of the larger of these establishments will have all the characteristics of complete urban centres. Finally, the Federal Government's rural land development schemes are centred around planned and compact self-contained village settlements. Many of these are already thriving miniature towns, while others are the nuclei of potentially similar centres (22).

The above picture of an ever increasing urbanization of the population in Malaya is even more remarkable in view of the fact that, with the possible exception of some of the larger centres such as Singapore, Penang, and the Kuala Lumpur, the towns of Malaya are predominantly servicing centres. The importance of

1. A state of emergency, later popularly referred to as 'The Emergency', was proclaimed on 16th June 1948 following the discovery of a communist plot to overthrow the Government. This state of affairs ended twelve years later on 31st July, 1960.

TABLE 4: DISTRIBUTION OF NEW VILLAGES IN MALAYA, 1955

STATE	Total new village population	Number of villages with less than 500 persons	Number of villages with 500 to 1,000 persons	Number of villages with 1,000 to 5,000 persons	Number of villages with more than 5,000 persons	Total number of villages
Penang	12,220	2	2	5	—	9
Malacca	7,730	11	3	2	—	16
Perak	211,940	50	28	62	6	146
Selangor	105,720	21	12	19	4	56
Negri Sembilan	29,630	19	11	9	—	39
Pahang	50,000	51	17	15	—	83
Johore	121,880	33	23	41	2	99
Kedah	22,360	21	13	5	—	39
Kelantan	16,390	34	6	4	—	44
Trengganu	1,600	3	1	—	—	4
Perlis	500	—	1	—	—	1
Total	579,970	245	117	162	12	536

TABLE 5: DISTRIBUTION OF TOWNS IN MALAYA, 1947 TO 1957

AREA	TOWNS WITH 1,000 TO 10,000 PERSONS		TOWNS WITH 10,000 OR MORE PERSONS		TOTAL NUMBER OF TOWNS	
	1947	1957	1947	1957	1947	1957
Penang	6	17	4	4	10	21
Malacca	5	7	1	1	6	8
Perak	43	100	4	9	47	109
Selangor	16	60	4	5	20	65
Negri Sembilan	8	24	1	2	9	26
Pahang	9	23	0	4	9	27
Johore	22	60	4	5	26	65
Kedah	14	32	2	3	16	35
Kelantan	5	21	1	2	6	23
Trengganu	10	15	1	3	11	18
Perlis	3	3	0	0	3	3
Federation	141	362	22	38	163	400
Singapore	21	39	3	5	24	44
Malaya	162	401	25	43	187	444

the major urban centres, including Singapore, Penang, Kuala Lumpur and Ipoh, in accounting for the high rate of urbanization should not be under-estimated. One third of the two million urban dwellers of Malaya in 1947 were in the city of Singapore. Another 22 per cent were in Kuala Lumpur, Penang and Ipoh. Thus these four major urban centres between them had more than half the total urban population of the country.

Though still retaining their position as the major urban centres of the country, their importance relative to the total urban population is, however, declining. This is largely because of (i) the growth of suburban and satellite dormitory and industrial areas and the resultant 'syphoning' of city populations by such centres; (ii) the creation of more towns by the resettlement programme and (iii) the comparatively more rapid growth of the smaller towns.

In 1957, Singapore contained 24.8 per cent, and the four major urban centres together had 43.2 per cent of the total urban population of Malaya compared with 33 and 54.8 per cent respectively in 1947 (Table 7).

The Federation of Malaya

In the Federation 26.6 per cent of the people were returned as urban dwellers in 1947. However, the degree of urbanization varied a great deal from one State to another. For instance, whilst 56.2 per cent of the people of Penang were classified as urban only 7.9 per cent of the population of Kelantan was so classified.

The urban population of the Federation, like the total population, is concentrated to a high degree in particular areas. More than 90 per cent of this section of the population in 1947 was in the Western States, with Penang, Perak and Selangor containing the major portion. These are the most highly developed

TABLE 6: COMPARATIVE GROWTH OF TOTAL, URBAN AND RURAL POPULATION IN MALAYA, 1947 TO 1957

			FEDERATION		SINGAPORE		MALAYA	
			1947	1957	1947	1957	1947	1957
Total			4,908,086	6,278,763	940,824	1,445,929	5,848,910	7,724,692
Urban			1,301,376	2,658,153	752,737	1,019,500	2,054,113	3,677,653
Rural			3,606,710	3,620,610	188,087	426,429	3,794,797	4,047,039
Increase 1947-1957	Actual Numbers	Total	1,370,677		505,105		1,875,782	
		Urban	1,356,777		266,763		1,623,540	
		Rural	13,900		238,342		252,242	
	Percentage	Total	27.9		53.7		32.1	
		Urban	104.3		35.4		79.0	
		Rural	0.4		126.7		6.6	

TABLE 7: PROPORTION OF THE URBAN POPULATION OF MALAYA IN THE MAJOR URBAN CENTRES OF KUALA LUMPUR, GEORGE TOWN, IPOH AND SINGAPORE, 1947 TO 1957

	TOTAL URBAN POPULATION		PERCENTAGE OF FEDERATION/ SINGAPORE URBAN POPULATION		PERCENTAGE OF FEDERATION/ SINGAPORE TOTAL POPULATION		PERCENTAGE OF TOTAL URBAN POPULATION OF MALAYA	
	1947	1957	1947	1957	1947	1957	1947	1957
Kuala Lumpur	175,961	316,230	34.3	25.5	9.0	10.8	54.8	43.2
George Town	189,068	234,930						
Ipoh	80,894	125,776						
Singapore	679,659	912,343	72.2	63.1	68.9	63.1		
Total	1,125,582	1,589,279	—	—	—	—	54.8	43.2

parts of the country (Table 3). The Western States also contained 137 out of 163 towns in the Federation in 1947, including the three major urban centres of Penang, Kuala Lumpur and Ipoh. These three between them contained more than a third of the total urban population of the Federation (Tables 5 and 7).

This pattern of distribution of the urban population of the Federation was not significantly altered in the next decade. In relation to the total urban population of the Federation, the proportion of urban dwellers in the Eastern States increased, while that of the three major urban centres decreased. In 1957 the Eastern States accounted for 12.2 per cent of the total urban population of the Federation compared with only 9.5 per cent in 1947 (Tables 3 and 7). The main reason for this increase appears to have been the Emergency resettlement programme, though the normal growth of population was also an important factor. Resettlement resulted in the creation of 128 nucleated settlements in the Eastern States. By 1957 the total number of towns in this region had risen to 68 compared with only 26 in 1947 (Tables 4 and 5).

Singapore

Eighty per cent of Singapore's inhabitants in 1947 were urban. More than 90 per cent of these were within the city area. The remainder were scattered in twenty-one minor urban centres, situated mainly near the city boundaries on the eastern side of the Island and along the trunk road to the Federation (Fig. 1).

By 1957 there was a slight modification of the above pattern. The proportion of the urban dwellers in the total population decreased to 70.5 per cent, compared

with 80 per cent in 1947 (Table 3), due primarily to the development of suburban housing and industrial estates which were settled by people from the congested city. This is illustrated by the fact that whilst Singapore city contained only 63.1 per cent of the total urban population by 1957, compared with more than 90 per cent in 1947, the number of minor urban centres on the Island had increased to 39, compared with only 21 in 1947 (Tables 5 and 7). The movement away from the city, and the development of other urban centres on the Island, is likely to be accelerated with the full implementation of the Government's Master Plan.

In 1957 most of the minor urban centres were still in the comparatively more developed eastern, north-eastern and south-eastern parts of the State. But, with the growth of new towns in the hitherto relatively underdeveloped western portions of the Island, the pattern was becoming more uniform (Fig. 2).

RURAL POPULATION DISTRIBUTION

With increasing urbanization the rural population has tended to become numerically less significant. This trend was accelerated by the Resettlement Scheme and the continuous drift of rural dwellers to urban centres. The Federal Government's rural land development schemes are having similar effects upon the rural population as the resettlement programme had in the early nineteen-fifties. Most of the pioneer settlers in these miniature towns are former rural dwellers. The combined effect of all this will probably be that in time the number of the dispersed rural dwellers in Malaya will be very much reduced, and it is even possible that they will be eliminated from the Malayan landscape.

The highest rural numbers are generally in quite different regions from those of the urban concentrations. For example, of the 3,800,000 rural inhabitants of the country in 1947 only 5 per cent were in Singapore Island, compared with the latter's share of 36 per cent of the urban population (Table 3).

The Federation of Malaya

A notable feature of the rural population distribution in the Federation in 1947 was that the Eastern States had a slightly higher proportion of the total rural population than they had of either the total or the urban population, reflecting the low degree of urbanization in these areas. The majority of the rural dwellers were, however, in the Western States, closely following the pattern of the distribution of the total population (Fig. 1). The pattern of distribution in the following decade remained virtually unchanged (Fig. 2).

Singapore

With the movement from the city area, supplemented by the normal growth of the rural population, Singapore's share of the total rural inhabitants of Malaya increased from 5 per cent in 1947 to 10.5 per cent in 1957 (Table 3). The rural population of Singapore is more evenly dispersed than that of the Federation. With the exception of the swampy coastal lowlands of the west, and the catchment area in the centre of the Island, few parts of Singapore were uninhabited in 1947. With the rapid increase in the total population even the low-lying western areas of Singapore were being settled by 1957. The largest numbers of rural dwellers were, however, still in the more intensely developed north-eastern and eastern sections of the Island (Figs. 1 and 2).

With 2,300 persons to the square mile in the rural areas in 1957, Singapore had by far the highest rural densities in Malaya, and the total population is increasing by more than 3 per cent annually.

CONCLUSION

In conclusion it may be said that Malaya has a dynamic pattern of population distribution in which a lack of uniformity in spatial concentration of numbers and a remarkable rate of urbanization are the outstanding characteristics.

Until the nineteenth century the population of Malaya was located mainly along the coast. But with the establishment of law and order in the Malay States, and the consequent influx of Chinese and Indian immigrants, the concentration of population moved inland from the coast to the tin and rubber belt in the foothills of Western Malaya, and, except for slight modifications, has remained there ever since. Though minor changes in the general distribution, consequent upon the development of the virgin areas, are to be expected, it is unlikely that the dominance of this region as the chief centre of the country's population will be challenged in the near future.

Finally, from a few small trading, mining, agricultural and administrative nuclei, Malaya's urban centres have multiplied at a phenomenal rate, both in size and numbers. Today, it is estimated that nearly 60 per cent of the country's people are urban dwellers. If the present rapid rate of urban growth is maintained, and there is no reason to believe that it will not be, Malaya might well challenge Japan as the foremost urbanized country of Asia in terms of the proportion of urban dwellers in the total population, though not in actual urban numbers.

REFERENCES AND NOTES

1. The 1957 population statistics are compiled from the *1957 Population Census of the Federation of Malaya, Reports Numbers 1-12* (Kuala Lumpur, n.d.), and from the *1957 Population Census, Singapore: Preliminary Releases, Numbers 1-17* (Singapore, 1959-60). These are preliminary reports and the figures quoted may be subject to change in the final publication.

2. Vlieland, C.A., *British Malaya: A Report on the 1931 Census* (London, 1932), pp. 8-10. Though Malays have been settled in the country since before the beginning of the Christian era the majority of the present day Malay population is descended from emigrants from Sumatra, Java, Borneo and other Indonesian Islands, who entered Malaya during medieval and modern times.

3. Ooi Jin-bee, 'Rural Development in Tropical Areas, with Special Reference to Malaya', *Journal of Tropical Geography,* Vol. 12, 1959, p. 11.

4. *1957 Population Census of the Federation of Malaya, Reports Numbers 2-12* (Kuala Lumpur, n.d.), Table 1.

5. *Report of the Working Party Set Up to Consider the Development of New Areas for Land Settlement in the Federation of Malaya* (Kuala Lumpur, 1956).

6. Federal Land Development Authority, *No Need to be Poor: A Policy Statement* (Kuala Lumpur, 1956).

7. Federal Land Development Authority, *Annual Report, 1958-1959* (Kuala Lumpur, 1960), pp. 8 and 32-5.

8. Federation of Malaya, *Second Five-Year Plan, 1961-1965* (Kuala Lumpur, 1961).

9. del Tufo, M.V., *Malaya: A Report on the 1947 Census of Population* (London, 1949), (a) Table 3; (b) pp. 43-4; (c) p. 43.

10. *1957 Census of Population, Singapore: Preliminary Release No. 2* (Singapore, 1959), Table II.

11. Tomasus, 'Development of Singapore Rural Areas 1949-1950', *Malaya*, 1953, pp. 526-6 and 591-3.

12. Colony of Singapore, *Master Plan: Report of Survey* (Singapore, 1955).

13. Ginsburg, Norton S., 'The Great City in South-east Asia', *The American Journal of Sociology*, March, 1955, p. 455.

14. 'Resettlement and the Development of New Villages in the Federation of Malaya, 1952'. *Minutes of the Legislative Council of the Federation of Malaya with Council Papers for the period March, 1952 to February, 1953* (Kuala Lumpur, 1954), Paper No. 33.

15. Corry, W.C.S., *A General Survey of New Villages: A Report to the High Commissioner for the Federation of Malaya, 12th October, 1954* (Kuala Lumpur, 1954).

16. The Federal Secretary's Office, *Statistical Information Concerning New Villages in the Federation of Malaya* (Mimeo., Kuala Lumpur, 1952).

17. Concannon, T.A.L., 'A New Town in Malaya: Petaling Jaya, Kuala Lumpur', *The Malayan Journal of Tropical Geography*, Vol. 5, 1955, pp. 39-43.

18. Department of Town and Country Planning, Johore, *Johore Bahru Town Plan* (Mimeo., Johore Bahru, 1960).

19. *The Malay Mail* (Kuala Lumpur), 27 February 1961, p. 6.

20. *The Straits Times* (Singapore), 4 February 1961, p. 4.

21. *The Straits Times* (Singapore), 4 July 1960, p. 12; and 6 July 1960, p. 4.

22. Findings of a field survey, carried out by the author in August 1960, of the State and Federal Land Development Schemes in Malacca.

BOOK REVIEW

CHANDI BUKIT BATU PAHAT, A Report on the Excavation of an Ancient Temple in Kedah. By Alastair Lamb.

Monographs on Southeast Asian Subjects No. 1 (Edited by John Bastin). Singapore: Eastern Universities Press Ltd., 1960. 10½ x 7½ inches. xiv and 108 pages; 40 diagrams; 179 plates. Malayan $15.

Present knowledge of the history of pre-European Malaya is by no means complete, and that which does exist is confused and obscure. There is a total lack of indigenous literary sources earlier than the sixteenth century, and what has so far been pieced together of Malaya's early past is based almost wholly on inferential evidence in foreign literary and epigraphical records. These foreign references, however, may be in any one, and often in more than one, of the Indian, Chinese, Arab, Indonesian or European languages, which introduces the problems of translation and transliteration. Also, the evidence of the different sources is often contradictory. In these circumstances it has been felt for some time that to attempt to reconstruct Malaya's early past on literary and epigraphical evidence alone is unsatisfactory; and that the literary and epigraphical evidence should be checked by means of archaeological investigations in the field.

With this in view, a number of interested persons, particularly Dr. and Mrs. H. G. Quaritch Wales just prior to the outbreak of the Second World War, and recently Dr. Alastair Lamb, carried out extensive explorations of northern Malaya. Dr. Lamb's *Chandi Bukit Batu Pahat* is the latest in the series of publications recording the findings of these archaeological expeditions. It is the most detailed account of any single archaeological site in Malaya. It is attractively produced on art paper and the text and maps are largely free from slips and misprints.

The monograph also includes two thousand dollars worth of photographs at the end of the text. These excellent plates are an outstanding feature of the report and form a valuable pictorial record of the excavations.

Dr. Lamb's monograph is the first of its kind in Malaya, and deserves all the praise of a pioneer study.

Kernial Singh Sandhu

LONGMANS GREEN & CO. LTD.

44, JALAN AMPANG, KUALA LUMPUR, MALAYA.

GEOGRAPHIES FOR ADVANCED STUDY Edited by S. H. BEAVER, M.A., F.R.G.S.

new titles and editions—

West Africa Second Edition 1960 by HARRISON CHURCH, B.Sc. (Econ). Ph.D. 50s. net

The Soviet Union Second Edition 1961 by G. JORRE. Translated and revised by E. D. LABORDE, Ph.D. 40s. net

Central Europe A Regional and Human Geography by ALICE F. A. MUTTON, M.A., Ph.D. Ready August, 1961 50s. net

Geomorphology by B. W. SPARKS, M.A. 37s. 6d. net

other titles in this series—

O'DELL: **The Scandinavian World** 45s. net

MONKHOUSE: **A Regional Geography of Western Europe** 50s. net

ROBEQUAIN: **Malaya, Indonesia, Borneo, and the Philippines** 42s. net

GOUROU: **The Tropical World** 20s. net

A full list of forthcoming titles may be had on application to the publishers.

UNIVERSITY BOOK STORE

13 ORCHARD ROAD, SINGAPORE 9.

O.C.B.C. BUILDING, MOUNTBATTEN ROAD, KUALA LUMPUR.

THE JOURNAL OF TROPICAL GEOGRAPHY

Formerly *THE MALAYAN JOURNAL OF TROPICAL GEOGRAPHY*

From two to four volumes of the Journal are published each year.

All correspondence concerning the Journal should be addressed to:

The Editor,
The Journal of Tropical Geography,
Department of Geography,
University of Malaya in Singapore,
Cluny Road,
Singapore, 10.

SUBSCRIPTIONS

The Journal is available, post free, on payment in advance at the rate of Malayan $5, U.S. $2.50 or 12s. 0d. sterling per copy.

CONTRIBUTIONS

Should be addressed to the Editor in double-spaced typescript, on one side of the paper only, and should not exceed 4,000 words. Authors should clearly state that their article is unpublished and not under consideration elsewhere. References in notes must include full details and be numbered consecutively. Illustrations, maps and photographs should be submitted in reproducible form with fully explanatory captions and a note to the Editor regarding the copyright. The Editor reserves the full right to adjust articles to conform with the Journal's format.

Directors: Robert Ho, M.A., Dip. Arts.
R. Wikkramatileke, M.A., Ph.D.

Editor: W. L. Dale, M.B.E., M.Sc. *Assistant Editor:* Ooi Jin-bee, M.A., D.Phil.
Business Manager: Lee Yong Leng, M.A., B.Litt.

PRINTED BY
CRAFTSMAN PRESS LTD.
SINGAPORE